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VOLUME 26 | FEBRUARY 22, 1937 | NO. 4

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Official Publication of the American Association of Textile Chemists and Colorists

THE OBJECTS OF THIS ASSOCIATION ARE:

"To promote increase of knowledge of the application of dyes and chemicals in the Textile Industry.

"To encourage in any practicable ways research work on chemical processes and materials of importance to the Textile Industry.

"To establish for the members channels by which the interchange of professional knowledge among them may be increased."

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AMERICAN
DYESTUFF REPORTER

VOLUME 26 FEBRUARY 22, 1937 NUMBER 4

Notes on

Waterproofing Pile Fabrics

T. RIDD

IN INSTANCES where it is required to render pile fabrics water-repellent, the proofing substance may either be applied jointly in the pile and the foundation, or to one of these only. In some cases, a different proofing substance from that used on the foundation is employed for the pile; for example, mohair plush with a cotton or linen foundation will have wax-proofed pile, the foundation being coated with rubber on the outer surface. In another instance, 100 per cent cotton pile goods may be lightly proofed with aluminum acetate, the foundation material subsequently receiving an additional proofing with soap or wax emulsion. These variations in procedure have to be adopted first in order to retain certain physical characteristics in the different fibers used for the pile in the various classes of goods and, secondly, to comply with certain stipulations made by the consumer regarding the efficiency of the water-repelling property.

Goods with a lustrous pile, such as rayon, natural silk and mohair velvet are seriously depreciated when processed with proofing substances which are satisfactory for 100 per cent cotton or cross-bred worsted pile goods. Again, a proof which is suitable for "panne" or flat-pile goods may not be equally suitable in the case of material wherein the pile is fully erect, since the proofing substance may clot the pile fibers to such an extent that the task of freeing them is rendered a difficult and expensive operation. Proofing substances consisting of insoluble soaps are prone to clot the pile and, furthermore, the luster of the latter always suffers through the coating of opaque, insoluble soap on the fiber.

Processes for rendering textile fabrics water-repellent have always attracted the attention of investigators: consequently, the number of patents which have been taken out for protecting this, that or the other proofing method is immense. It is, therefore, expedient that persons desiring to take up practical processing of proofing methods with which they are unfamiliar should first ascertain the patent position. This precaution is particularly necessary where proofing with rubber latex is concerned since this substance is a comparatively recent entry into the field of textile proofing.

One of the oldest methods of proofing textiles of every description utilizes a solution of aluminum acetate, or "red-liquor." This proof is suitable for pile fabrics of all kinds and the luster of mohair, rayon or natural silk pile does not suffer provided an impregnating bath of moderate strength is used. Unfortunately, however, goods proofed with aluminum acetate alone only possess water-repelling power of a moderate order, hence this method of proofing is only in limited use. Aluminum acetate frequently contains a variable amount of aluminum sulfate, especially when unskillfully prepared. The presence of an excessive amount of sulfate in a sample abstracted from a bulk lot of aluminum acetate intended for use in proofing should be taken as plain warning of unsuitability for the purpose in view. A simple means of determining the presence of sulfate will be given later.

The usual strength of an aluminum acetate proofing bath is 3° Tw., higher concentrations than this being apt to harshen animal pile. A kettle fitted with an overhead reel is used when impregnating the goods with the proofing liquor; where the pile is sufficiently robust to withstand crushing, the adoption of an apparatus furnished with light nip-rolls will result in better penetration. Certain classes of pile goods can be proofed in the latter type of apparatus without incurring the risk of pile distortion; for example, mohair plush and Utrecht velvet and cross-bred worsted bear-skins.

Although animal fiber will only absorb a limited amount of aluminum acetate from a cold bath it is in many instances inadvisable to use heated liquor for the following reasons: (1) a hot bath harshens animal pile; (2) goods colored with the looser dyes frequently undergo a serious change in shade in a hot proofing bath. In cases where pile goods with mohair and cross-bred worsted pile have been steamed under pressure before scouring and dyeing, it is found that the animal fiber absorbs more aluminum acetate from a cold bath than unsteamed material. In any event, the affinity of aluminum acetate for animal fiber in a cold bath is so low that it is next to useless to treat the stock to a brief passage through the impregnating bath. It is, therefore, the practice to allow the goods to circulate

for about ten minutes in the proofing bath. They are then thoroughly centrifuged, stretched, dressed and dried at a temperature of about 60° C.

In cases where it is only necessary to proof the cotton or linen foundation in pile fabric, a strong solution of aluminum acetate is slightly thickened with tragacanth, or some other non-farinaceous thickener and the preparation is then applied to the backing material by means of a skimming apparatus containing a furnishing roll and a series of rotary brushes to ensure an even distribution of the proofing substance. When a batch has been processed in this manner, great care has to be taken to avoid contact between the pile surface and the outermost side of the foundation since the thickener contained in the proofing would encourage the adherence of a proportion of aluminum acetate to the pile fibers with possible development of stains in the case of sensitive dyestuff employed in coloring the pile. Furthermore, no time must be lost in drying the backing following application of the proofing substance since seepage of aluminum acetate from the base to the tips of the pile fibers may occur where it is neglected to dry the stock within a reasonable time following back-skimming.

Other points to attend to when proofing pile goods with aluminum acetate will now be indicated. First, there is the matter of sulfate content in the stock solution. If the sulfate content exceeds about 1 per cent, cloudy patches may develop in the goods during drying, or at a later stage of processing. In some instances where these stains have developed, it would appear that the phenomena is due to crystallization of residual aluminum sulfate introduced into the stock at the time of proofing. In other cases, the explanation may be that the dyestuff has been affected by the concentration of aluminum sulfate at certain points. This seems to be a likely explanation in instances of sulfur colors which have not been permitted to become fully oxidized previous to impregnating with an impure aluminum acetate. The first essential in obviating defects of the above nature is to examine every batch of aluminum acetate for sulfate content before using it for proofing. The next precaution is to thoroughly centrifuge the stock after it leaves the proofing kettle. Hydro-extraction by passage of the fabric through nip-rolls is not to be recommended.

If the aluminum acetate has been prepared in the plant by the double decomposition of aluminum sulfate and acetate of lime, it is possible that slack processing on the part of the person responsible for the preparation of the proofing liquor has resulted in a high sulfate content in the finished product. If a sample is tested with barium chloride and a precipitate appears, this indicates an excess of aluminum sulfate; if a further sample is tested with ammonium oxalate, the presence of undecomposed acetate of lime will be indicated by a precipitate also. These tests ought to be conducted shortly after the solution of aluminum sulfate has been agitated with the acetate of lime so that any deficiency or excess of either chemical can be rectified before the stock solution of aluminum sulfate-acetate is separated by filtering from the insoluble calcium sulfate.

It has already been stated that textile stock proofed with aluminum acetate alone only develops water-repelling power of a moderate order. If, however, alumina-proofed goods are suitably treated with solid wax, a solution of wax, or an emulsion of wax, the power of repelling water is enhanced. The apparatus employed when applying solid wax to pile fabric utilizes rolls cast from pure beeswax, or a mixture of this with stearine and paraffin wax. During passage through this machine, the pile comes into close contact with one or a number of rapidly rotating wax rolls and a portion of the wax is transferred to the pile fibers. The coating of wax is subsequently burnished through contact with a series of rotary brushes incorporated in the apparatus. This method of proofing is usually confined to 100 per cent cotton velvet or "velveteen"; goods with animal pile are commonly proofed with wax emulsion. The method of proofing with a solution of wax in benzine, etc., is not employed with pile fabric of any description, so far as the author is aware.

Although a wax emulsion proof costs more than a proof in the wax-roll apparatus, the former method gives a better result so far as the property of repelling water ultimately developed in the goods is concerned. It is easy to perceive that a wax emulsion will penetrate the stock better than particles of solid wax can do when processing is carried out in the wax-roll apparatus recently described, since the particle-size in the case of emulsified wax is probably of a minute order. Moreover, an aqueous dispersion of wax will entirely surround the individual fibers in the pile where an immersion process is employed, whereas mechanical limitations in the case of processing in a wax-roll apparatus render the complete encirclement of the pile fibers with a film of wax an impossibility. Owing to the amount of friction exerted on the pile in the case of processing in the wax-roll apparatus, this machine is unsuitable for use on goods with rayon pile since the fibers are liable to fracture and permanent distortion.

The wax content of commercial wax emulsions is said to vary from 10-30 per cent. Some of these emulsions are marketed in the form of white jelly, while others consist of a thick fluid resembling dairy cream. The original emulsion readily disperses when agitated with warm water but it is wise to sieve the dispersion before putting it into the proofing kettle. A certain number of wax emulsions are stable in the presence of aluminum sulfate-acetate hence it is possible to dispense with a separate impregnation with the latter substance in cases where the dual proof is specified by the consumer. It is said that certain makers of wax emulsion now market products containing a suitable proportion of aluminum acetate. It is probable that the user of such a preparation pays in the long run a good deal more for his proofing than the man who prefers to make up his proofing bath from aluminum sulfate-acetate

and wax emulsion in the ratio which experience has shown him to be suitable for the particular type of goods on hand.

Aqueous dispersions of wax emulsion are generally applied to pile fabric by a simple immersion operation. In instances where the consumer objects to the somewhat greasy handle of the pile surface in wax-proofed stock, it is customary to process the foundation alone with wax emulsion, the pile either being proofed with aluminum sulfate-acetate or else not proofed at all. In a case where the foundation alone is to be proofed with wax emulsion, processing is done in the back-skimming apparatus which has been mentioned elsewhere in this article. A fairly concentrated dispersion of wax emulsion is used for back-skimming since, if made too thin, the emulsion would seep through the backing and saturate the pile. It is, of course, necessary to dry the pieces immediately they leave the back-skimmer, great care being taken not to permit the pile surface to come into contact with the wet outer surface of the foundation. Stock to be back-skimmed in the manner under discussion is fully dressed previous to back-skimming, the only finishing operation required after proofing and drying being the shearing of the pile.

In cases where an immersion in wax emulsion is adopted, a dispersion of 2 per cent strength is used. This is generally found adequate for the purpose of shower-proofing; a stronger bath than that aforementioned is employed when it is desired to reduce the bristly handle of pressure-steamed mohair pile goods. A cold bath is frequently employed with colored stock, particularly where the dyestuff is not of good fastness to warm water. Peroxide-bleached material is often proofed in a warm bath; there seems little doubt that the employment of warm liquor results in better penetration of the emulsified wax, particularly in instances where the goods have mohair and cross-bred worsted pile. If a warm bath is adopted when processing natural silk, rayon and mohair pile stock, a temperature of about 40° C. should not be exceeded otherwise distortion of the pile may result since there may be practical difficulties in the matter of achieving uniform cooling of the goods when they are ready for removal from the proofing kettle. The use of squeeze rolls ensures good penetration of the emulsion; unfortunately, squeeze rolls damage the pile in some cases, especially if a warm bath is employed. The lighter classes of dress velvet with rayon pile are usually wax-proofed in a star-kettle since there is less risk of pile distortion if processing is done in this form of apparatus than where a vessel with a reel of the usual type is employed.

It is advisable to allow the heavier classes of pile fabric at least ten minutes processing in the wax emulsion bath. Upon the elapse of the stipulated period, the pieces should be taken up around the reel and left thereon for a few minutes so that the surplus liquor may drain into the kettle. The goods are then centrifuged, stretched on the dressing frame and, after the pile has been carded and brushed, the batch is ready for drying. During the operation of dressing the pile, attention is paid to freeing the numerous clots which develop during the proofing process, particularly where a strong bath has been employed. If the proofing bath is out of condition, numerous particles of solid wax attach themselves to the fibers in the pile and their removal during the dressing process is often a most troublesome operation. For this reason, it is the practice to discard a used bath of wax emulsion after some little use, irrespective of whether it appears to be in good condition or not.

It has already been pointed out in the present article that the method of water-proofing textile materials by alternate treatment with solutions of aluminum sulfate-acetate and soap is unsuitable for pile fabric inasmuch that the sticky metal soap which is deposited on the goods depreciates the luster of animal or rayon pile and also clots the fibers. It is, however, feasible to employ alumina soap for water-proofing the vegetable fiber commonly used for the foundation in pile goods. In instances where this method of proofing is adopted, the proofing agents are applied to the backing of the fabric by means of the back-skimming apparatus to which allusion has already been made. The rough surface of insoluble metal soap which forms on the back of the fabric after repeated alternate applications of aluminum sulfate-acetate and soap solution is subsequently levelled-off and simultaneously forced into the interstices of the foundation fabric by treatment of the stock in a burnishing apparatus. During the passage of the material through the burnisher, the backing is forced into close contact with a series of heated rolls revolving in the opposite direction to the movement of the fabric being processed. Under the combined influence of heat and friction, the rough coating of alumina soap is rendered smooth. By incorporating plasticisers like rubber and linseed oil in the soap solution, together with a proportion of coloring matter, a surface in imitation of leather can be built up on the backing in order to render more realistic an animal pelt effect in the pile surface. The use of rubber for water-proofing pile fabric is confined to the rubberizing of the backing only since a deposit of rubber on the pile fibers would cause serious clotting. The rubber mix or "dough" is applied to the backing of pile goods by means of a spreading apparatus wherein the fabric is made to pass in open order between a rubber roll and the blade of an iron doctor set at a suitable distance above the roll. When rubberizing a piece of goods, an operative distributes a suitable amount of dough across the width of the cloth, the dough being subsequently levelled to form an even coating during the passage of the cloth under the doctor. When the fabric leaves the doctor, it passes through a heated tunnel in order that the solvent in the dough may evaporate. Several coats of rubber are given in instances where it is desired to develop a non-skid surface, such as is wanted in the case of pile fabric for conversion into hearth-rugs and floor-mats, or to form imitation turf for indoor golf and tennis "greens."

Whenever it is necessary to reduce the adhesiveness of the coating of rubber before curing it, a quantity of talc

or starch powder is dusted on. Any talc, etc., inadvertently reaching the pile surface generally proves troublesome to remove without first wetting the piece and then re-dressing it. In slight cases of soiling of this sort, it is sometimes possible to cleanse the pile fibers by beating and brushing, this treatment being followed by application of a domestic suction cleaner to the affected areas. When the rubbered goods leave the spreading apparatus, they are ready for the curing of the coating of rubber that has been put on the backing. If the deposit of rubber is a light one, a cold curing process with sulfur chloride is adopted. In this cure, the rubbered surface of the fabric comes into contact with a solution of sulfur chloride in carbon disulfide, the solution being applied by a hardwood roll which revolves in a trough filled with it. The carbon disulfide is subsequently evaporated off during passage of the fabric through a heated tunnel.

The aforementioned process of curing is not suitable for use in the case of heavily rubberized material since the solution of sulfur chloride fails to penetrate a stout coating of rubber. In instances where the cold cure is unsuitable, the rubber is either cured by the application of dry heat or else by treating it for a period with live steam under suitable pressure. The latter method of curing is seldom employed with rubberized pile goods; however, this method of curing rubber will be mentioned again in the present article. In the heat curing process, atmospheric air at a temperature of about 120° C. constitutes the vehicle for applying the necessary heat to the rubber. The duration of the heat cure is from 20-120 minutes.

In instances where the use of heat at temperatures over 100° C. is detrimental to the goods, as in the case of material with acetate rayon pile, curing of the rubber is either conducted at a temperature somewhat below the aforementioned figure, or else the operation is performed at normal atmospheric temperature. To achieve an efficient cure without the use of heat, an ultra-accelerator is employed in place of an accelerator of the ordinary type.

It is generally known that the presence of copper salt in a rubbered fabric is detrimental to efficient curing, particularly if the cure is carried out by the cold method. Copper salts exert a powerful catalytic effect on the rubber vulcanizate, oxidation and eventual degradation of the rubber ensuing in instances where the copper content in the goods exceeds about 0.01 per cent. It is, therefore, essential that copper salts be not utilized as dyeing or after-treating assistants for textiles which require rubberizing. Similarly, dyestuff containing copper has to be shunned. Most mohair pile fabric intended for conversion into domestic rugs and mats of a non-skid type with rubberized backing is provided with yarn-dyed jute and cotton, or 100 per cent cotton foundation colored with sulfur black. This dyestuff does not require after-treatment with copper salt. It is customary to dye the pile after the pieces have been woven, either logwood or acid black dyestuff being employed for processing. Since pile goods are depreciated by lengthy processing in the dyebath, it is the practice to utilize a single-bath method when dyeing such stock logwood black. The usual components in single-bath logwood black comprise logwood extract, copper sulfate, iron sulfate and oxalic acid. This combination gives satisfactory results on pile fabric with animal pile but cannot be used on goods which are to be rubberized. In this event, it is customary to omit the copper sulfate from the dye-kettle and to make an extra addition of iron sulfate to compensate for omission of the other metal salt.

Another snag to be encountered in rubberizing pile fabric consists in trouble due to tackiness, swelling and ultimate degradation of the rubberized area in cases where the goods contain an excessive amount of grease and oil. Mineral oil has a more harmful effect on rubber than vegetable oil. It is generally conceded that 2 per cent of residual oil in goods for rubberizing is the permissible maximum. Since reputable spinners of mohair and worsted stock for conversion into pile goods use a lubricant principally consisting of olive oil, degradation of the rubber through residual mineral oil in cases of rubberized goods is unlikely. The method for curing rubber which consists in processing the coated goods while tightly wrapped on a roll cannot be employed in the case of fabric with erect pile since the fibers in the latter are flattened down and seriously distorted by the influence of steam and mechanical pressure of one lap of cloth against another. Steam-curing is a feasible proposition however, in the case of goods with flat pile: for instance, fabric imitations of pony and reptile hide. The live steam employed in this method of curing rubber sometimes affects the shade of the dyestuff on the animal pile and, in certain instances, reduction of the dyestuff may occur, particularly if over moist steam is used. This contingency, fortunately, is not often encountered because the dyestuff employed in the color-printing of the pile is chosen because of the ability to withstand processing with moist steam to fix the dyestuff.

It will readily be perceived that material with flat-pile is much easier to cope with during the rubberizing of the backing in a spreading apparatus than fabric with long pile, or with short erect pile for, in the two latter instances, the bulk and resilience of the pile fabrics render batching on the let-off and take-up rolls somewhat troublesome operations. Indeed, some plants have installed batch rolls with flanged ends to facilitate even rolling of the stock. Another way to circumvent the batching difficulty is to employ a spreading machine provided with a pair of endless chains studded with pins to engage the selvages of the fabric to be rubberized. The fabric is tensioned to a suitable width by means of a screw attachment to the selvage chains and is afterwards drawn under the blade of the doctor as the chains move through the apparatus. This apparatus is also suitable for tensioning pile fabrics to be rubberized by spraying with latex in accordance with one or other of the recently patented processes for applying rubber latex to textiles.

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American Association of Textile Chemists and Colorists

FEBRUARY 22, 1937

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Members should notify the **Secretary** immediately of all address changes

ANALYTICAL METHODS

The Council has authorized the republication of the "Analytical Methods for a Textile Laboratory" in the 1937 Year Book. The committee in charge of this section will be glad to correct any errors or omissions in these methods as published in the 1935-36 Year Book. The members of the A. A. T. C. C. are therefore requested to review these methods and send to the chairman of this committee not later than March 15, 1937, any suggestions for the improvement of the existing methods or any new methods which seem suitable to include in this section.

Walter M. Scott, Chairman,
857 Boylston Street,
Boston, Massachusetts.

INTER-SOCIETY COLOR COUNCIL

THE Sixth Annual Business Meeting of the Inter-Society Color Council will be held at the Waldorf-Astoria Hotel, New York City, on Thursday, February 25, 1937, at 2:00 P. M. At 7:30 P. M. of the same day the Inter-Society Color Council will hold a joint meeting with the Illuminating Engineering Society in the Auditorium of the New York Electrical Association (17th floor, Grand Central Palace). At this meeting the speakers will be Dr. Deane B. Judd of the Bureau of Standards, who will present a paper on chromatic filters, and Mr. Jonel Lesco, stage-setting designer for the Metropolitan Opera Company.

The A.A.T.C.C. is a member of the Inter-Society Color Council, and all members of the A.A.T.C.C. are cordially invited to attend these meetings.

—— ♦ ♦ ——

MEETING, PHILADELPHIA TEXTILE SCHOOL STUDENT SECTION

A MEETING of the Philadelphia Textile School Student Section was held on Wednesday, February 3, 1937, at 3:00 P. M. The speaker was Mr. E. C. Fish, of the Standardization Laboratory of the DuPont Co., whose topic, "Standardization of Dyestuffs," proved to be very interesting.

Respectfully submitted,
WAYNE F. FRY, *Secretary.*

The Influence of Position Isomerism on the Color and Dyeing Properties of Mono Azo Dyes*

WALLACE R. BRODE and MARION E. GRIFFITH†

THE work described in this paper is a part of a general problem concerning color and chemical constitution and in part involves material which has been prepared by Dr. D. R. Eberhart of the Calco Company. We would also like to express our appreciation to Dr. E. F. Hitch and the E. I. du Pont dye works for assistance in the preparation and supplying of certain of the intermediates which were used in this work.

In the previous problems which have been completed in this series[1] of papers, certain dye types have been prepared in which the variation in structure involved the migration around the molecule of certain substitution groupings such as Chlorine, Sulfonic or Methyl. A careful study was made of these series of dyes with regard to their absorption spectra in various solvents in both the visible and ultra-violet portions of the spectrum. The ultimate object of such a study was, of course, to prepare sufficient data so that the structure of an unknown dye might be predicted from its absorption spectra, and also that one might be able to predict the color of a dye from its structural formula.

Most of the dye types in the above series have been chosen from the standpoint of simplicity of structure and quite often have been quite unsuited for dyeing of fabric. In the series which is discussed in this paper the dyes were for the most part quite suited for fabric dyeing, and several of them are produced commercially in rather large amounts (such as Orange II). Hence, it was quite natural that the usual physical observations which involved absorption spectra measurements should have been extended to include the dyeing properties of the dyes. The dyeing properties observed included exhaustion, light-fastness (fading and darkening), and washing-fastness. All of these observations were made by the use of absorption or reflection spectra data from solutions of the dyed fabric.

The various dye types which have been studied or are in the process of being studied include the mono-azo, disazo and polyazo dyes, triphenyl methane dyes, hydroxyanthraquinone, indigo, thioindigo, phthalocyanine, and nitrophenols. Where possible, data in these series will be prepared on the dye properties as well as the color or absorption spectra measurements.

DYES AND PREPARATION

The dyes in this series were prepared by the diazotization of aniline, ortho sulfanilic acid, metanilic acid, or para sulfanilic acid, and coupling to form the mono-azo dyes with the available naphthols and naphthylamines and their mono-sulfonated derivatives. Not all of the possible isomers have been prepared, but from the seventy isomeric dyes which were prepared and studied, it has been possible to draw certain definite conclusions.

The Naphthol series of dyes was prepared by one of us (M. E. G.) while the Naphthylamine series was prepared by Dr. D. R. Eberhart. The same general methods of preparation were used in both series, although in the Naphthylamine series purification was improved through the use of the Diphenylguanidine method[2]. The dyes were analyzed by the titanous trichloride titration method[3]. The preparation and analysis of these dyes have in part been described in the printed literature[4] and the remainder will be described in forthcoming publications.

ABSORPTION SPECTRA

The absorption spectra of the solutions of the purified dyes were observed visually with a spectrophotometer and recorded photographically in the ultra-violet by the Hilger sector-photometer method[5]. A few of the prepared dyes, especially those with one or no sulfonic acid groups, lacked sufficient solubility for observations in the aqueous solvents which had been chosen. A study of the visible and ultra-violet absorption of these dyes shows that they can be divided into three structural types on the basis of the

*Presented at Saturday afternoon session, Annual Meeting, Providence, R. I., December 5, 1936.

†Ohio State University.

[1]See Brode and Piper, Journal of the Am. Chem. Soc., Vol. *57*, p. 135 (1935) for reference to earlier papers.

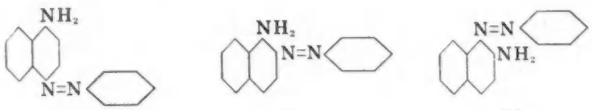
[2]Rose, Ind. and Eng. Chem. *25*, 1028 (1933).

[3]Kolthoff and Robinson, Rec. Trav. Chim. *45*, 169 (1926); Calcott and English, Ind. Eng. Chem. Vol. *15*, 1042 (1923).

[4]M. E. Griffith and W. R. Brode, Bulletin No. 565, April, 1936, Ohio Agricultural Experiment Station; D. R. Eberhart and W. R. Brode, Doctors Dissertations, *18*, 123 (1936). The Ohio State University Press.

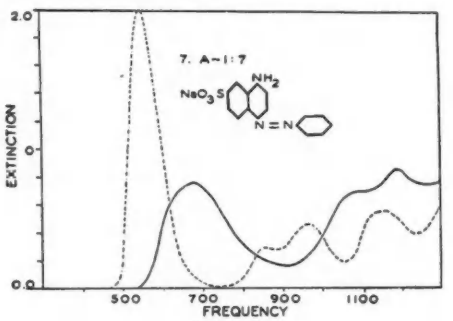
[5]Brode, Bureau of Standards J. of Research, *2*, 501 (1929); J. Am. Chem. Soc. *56*, 2172 (1934).

parent non-sulfonated amino-azo dyes. These three types are:

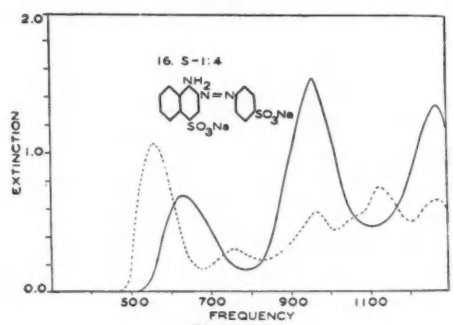


I II III

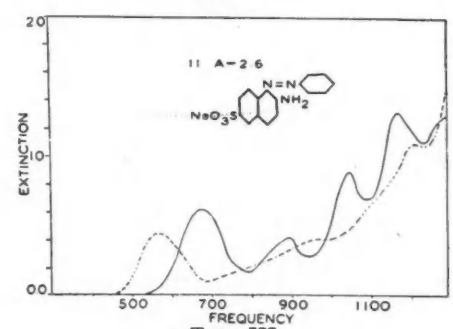
Type II is formed whenever sulfonic acid groups occur in positions 3, 4, or 5. The absorption curves are quite different for each dye type, as one would expect. The accompanying graphs are representative examples of these three types. (Figs. 1, 2 and 3.)



Type I



Type II



Type III

Figs. 1, 2 and 3—Absorption Curves for Dye of Type I, Type II and Type III.

In the amino series the neutral curves of Type I dyes are characterized by strong primary bands between 600 and 700 fresnels[6] and two secondary weaker bands, close together at positions of about 1080 and 1200 fresnels. Curves of Type II dyes are characterized by three strong, well-separated bands of rather uniform intensity and situated at approximately 640, 960, and 1272 fresnels. Curves of dyes of Type III are distinctly different. The primary bands are much weaker than those of the other two types. A still weaker second band occurs at approximately 880 fresnels, and then the absorption rapidly increases to give additional often ill-defined maxima of considerable intensity beyond 1100 fresnels.

The acid curves of these dyes somewhat resemble the corresponding neutral curves. In Type I dyes, the primary maxima are very strong, ranging from two to four times the strength of the corresponding neutral curves. There are three to four rather weak secondary maxima, which, when four are present, usually occur in pairs. Type II dyes show, in general, strong primary maxima of one and one-half to two times the strength of the neutral maxima, followed usually by three weaker secondary maxima of gradually increasing strength. Type III dyes are again quite different. The primary acid bands are usually weaker than the corresponding weak neutral maxima. The other maxima show increasing strength with the absorption in the far ultra-violet often being three to five times that of the primary band.

While the data on the ultra-violet absorption spectra of both the naphthol and naphthylamine series have been recorded and will be discussed in detail at a later time, a brief summary of the observed effects in one of these series may be of interest in showing the application of the data to molecular structural variations.

In both the naphthol and naphthylamine series a Type I dye shows the lowest frequency of the primary absorption band when the sulfonic acid group is in the 8-position, and the highest frequency in the 2-position (Fig. 4). In Type II dyes, moving the sulfonic acid group through the positions 3, 4, and 5 gradually decreases the frequency, although the effect is not great. Type III dyes show more irregularity although the effect is to decrease frequency slightly in order of substitution in the 5, 6, and 7 positions, and to decrease frequency considerably in passing from the 2:7 dye to the β naphthylamine dye.

Change of solvent from neutral to acid produces the expected decrease in frequency of the principal band and introduces more maxima in the ultra-violet portions of the curves. A particularly interesting fact is the reversal of frequency trend in the "para" coupled Type I dyes, and not in the dyes of Types II and III. In Type I dyes, the strong bathochromic effect of a sulfonic acid group in the 8-position in neutral solution becomes a hypsochromic effect in acid solution, while the hypsochromic effect of 2-substitution becomes strongly bathochromic in acid solution. In terms of total frequency shift with change of solvent, the value for 8-substitution is smallest and that for 2-substitution much the greatest.

In the "para" and "ortho" coupled α amino dyes, the

[6]Fresnel—Frequency unit—vibration divided by seconds x 10^{12}= reciprocal of wave length x C.

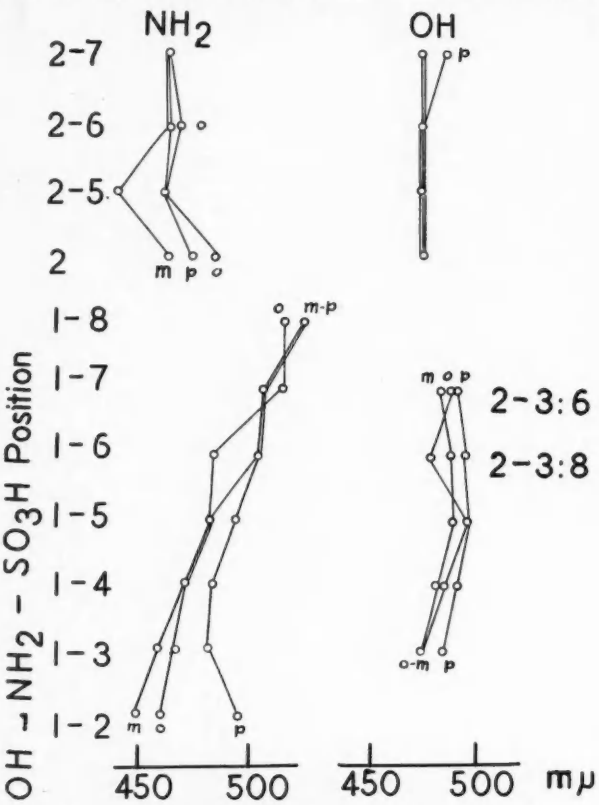


Fig. 4—Position of Absorption Band of Naphthol and Naphthylamine Dyes.

order of increasing frequency is sulfanilic, metanilic, orthanilic, and aniline, while in the ∝ coupled β amino type, the order is changed to orthanilic, sulfanilic, metanilic, and aniline. On shifting to acid medium, the general trends are the same as in neutral solution except for the aniline dyes which consistently show the lowest frequency of the group.

DYEING AND EXHAUSTIVE PROPERTIES

Fabric samples of white wool cashmere weighing 3.25 grams were used. Before dyeing, the wool was scoured by boiling for 15 minutes in an 80 volume bath of 0.5 per cent neutral soap solution and was then thoroughly rinsed. A glycerol-water dyebath was used in dyeing, and in each case dyeings were made in duplicate, according to the following procedure[7]:

The wool was wet out hot and entered in a 50 times bath (at 49° C.) containing 1 per cent of dye, 20 per cent of Glauber's salt, and 5 per cent of acetic acid (28 per cent). The temperature was raised to boiling in 15 minutes and boiling continued for 45 minutes.

One per cent of concentrated H_2SO_4 was then added and the boiling continued for 30 minutes. The wool was rinsed, extracted, dried, and ironed with a medium hot iron.

The amounts of dyes and chemicals used are expressed as percentages of the weight of the wool.

Solutions of the dyestuffs used in dyeing the fabrics were analyzed for exhaustive properties with a spectrophotometer. The dye solutions were prepared for analysis in the same manner as that used for the dyebath, the same amount of sodium sulfate, acetic acid, sulfuric acid, and dyestuff being added. The exhausted solutions were made up to the original volume and portions taken for analysis. From the curves obtained the difference at the maximum absorption band was obtained, and, from this, the degree of exhaustion of the dyebath was determined. The duplicate exhausted solutions varied in degree of exhaustion by less than one per cent in all cases. The degree of exhaustion varied with the different dyestuffs from 5 to 30 per cent. Observations were made only in the visible portion of tht spectrum.

The reflection of light from the dyed samples was measured with the spectrophotometer, using a reflection sphere. Duplicate readings for the original dyed samples, the washed samples, and the samples exposed to light in the Fade-ometer were taken. Corrections were made for the reflection of a piece of the same washed fabric before dyeing. The amount of fading was determined from the relative drop of the extinction coefficient at the maximum of the absorption band. The darkening was determined from the relative increase in extinction of the flat portion of the absorption curve (usually between 610-630 mμ). This value was corrected for pure dye absorption by subtraction of the extinction value observed in the unfaded fabric, which, in turn, had been corrected for loss in fading.

EXPOSURE TO LIGHT

Two methods are usually used for testing light fastness. The first is exposure to direct sunlight, and the second, exposure to an artificial light. The carbon arc has been found to be the most satisfactory source of artificial light. The Fade-ometer is an instrument using the carbon arc. Since it affords the much more convenient and rapid method of producing fading and is particularly useful for testing in the fall and winter, it was used in the study reported here. The Fade-ometer has a different spectrum from the sun, but its fading action is similar. Robertson[8] made a comparative study of the fading produced by the Fade-ometer (Type LV) and by the sunlight at Columbus, Ohio, and found that there was only a slight difference in the fading produced by the two methods.

Tests of from 40 to 50 Fade-ometer hours are usually adequate to determine whether or not a color will fade[7]. Since very little fading (in some cases none) visible to the eye was produced by 40 hours and later 80 hours, the samples in the study reported here were exposed for 120

[7]American Association of Textile Chemists and Colorists, 1933. 1932 Year Book, Howes Publishing Co., New York, N. Y.

[8]Robertson, H. Bi-monthly Bulletin, No. 169, July-August, 1934, Ohio Agricultural Experiment Station.

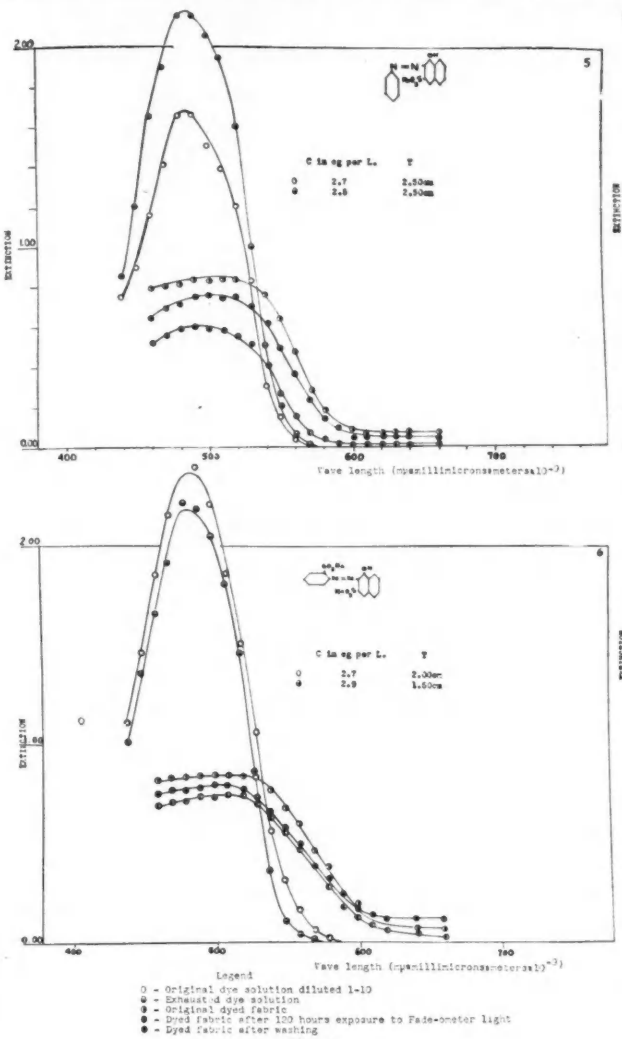

5
C in ag per L. T
0 2.7 2.50m
● 2.5 2.50m
6
C in ag per L. T
0 2.7 2.00m
● 2.9 1.50m
Wave length (mμmillimicronsmeteras10⁻⁹)
Legend
0 - Original dye solution diluted 1-10
● - Exhausted dye solution
● - Original dyed fabric
● - Dyed fabric after 120 hours exposure to Fade-ometer light
● - Dyed fabric after washing

Fig. 5

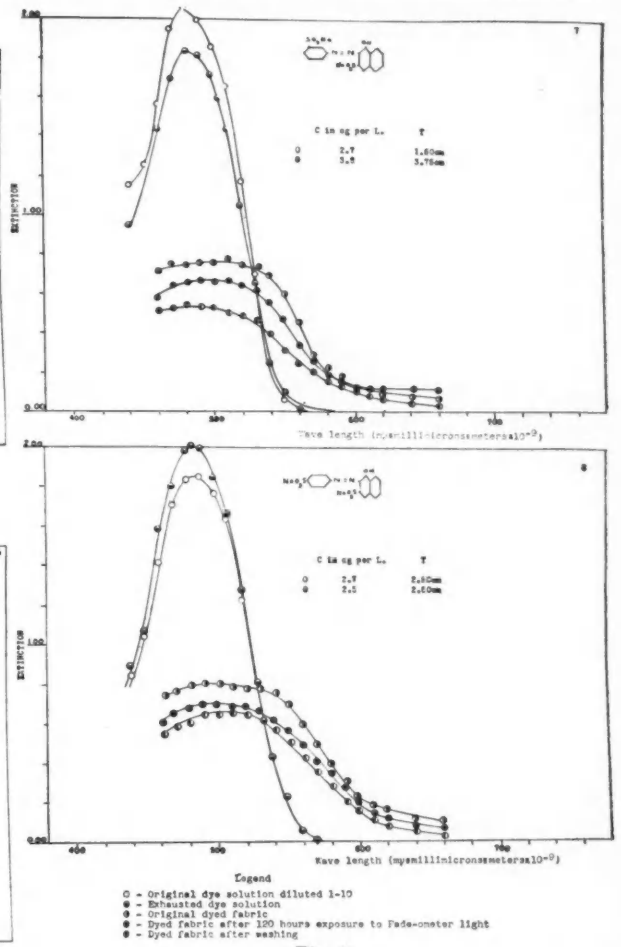

7
C in ag per L. T
0 2.7 1.60m
● 2.5 1.75m
8
C in ag per L. T
0 2.7 2.60m
● 2.5 2.60m
Wave length (mμmillimicronsmeteras10⁻⁹)
Legend
0 - Original dye solution diluted 1-10
● - Exhausted dye solution
● - Original dyed fabric
● - Dyed fabric after 120 hours exposure to Fade-ometer light
● - Dyed fabric after washing

Fig. 6

Figs. 5, 6, 7 and 8—Absorption Curves showing Exhaustive and Fading Properties.

hours. The average temperature was 120° F. and the average relative humidity, 30 per cent, as recorded by a hygrothermograph.

LAUNDER-OMETER WASHING TESTS

The washing test was made in a Launder-ometer at 49° C., using 100 cubic centimeters of a 0.5 per cent neutral soap solution, as recommended by the American Association of Textile Chemists and Colorists[7]. The machine was allowed to run 30 minutes, after which the samples were rinsed several times in warm water. They were then rinsed in cold water, squeezed, and dried in a current of air at room temperature before a fan. Duplicate samples, each measuring 2½ by 3 inches, were placed in each jar.

COLOR ANALYSIS

The most satisfactory method of analyzing visible color is by means of a spectrophotometer. This instrument measures the amount of light reflected from or transmitted by the colored sample at any wave length throughout the spectrum. Spectrophotometric analysis provides a convenient and rapid method for the analysis of dyestuffs and of dyed fabrics. The light absorbed by a dyed sample is proportional to the logarithm of the concentration of the dyestuff taken up by the fabric[9]. To obtain numerical expressions for the loss of color due to washing, it is necessary only to express the change in terms of the percentage difference in reflectance at any one wave length. Light fading which involves both a loss in brightness and a change in hue may also be expressed numerically.

DISCUSSION OF RESULTS

The data obtained from these studies are indicated in tabular form in Tables I, II, and III, and examples are given of individual dyes in Figures 5, 6, 7, and 8. In order to permit better observation and comparison, a portion of this data has been arranged in graphical form

[9]Shelton, E. M. and R. L. Emerson, 1932. Ind. and Eng. Chem., Anal. Ed., 4: 248-253.

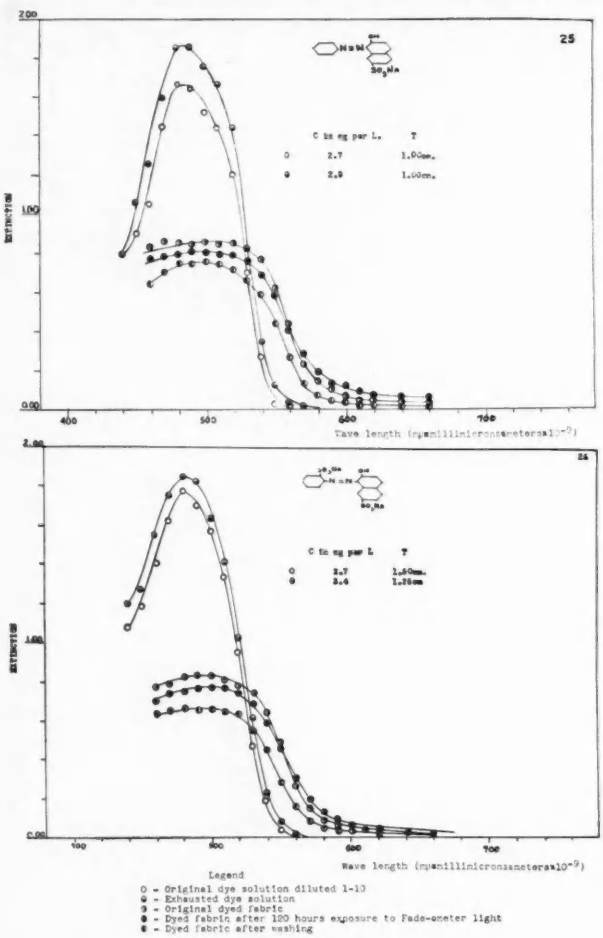


Fig. 7

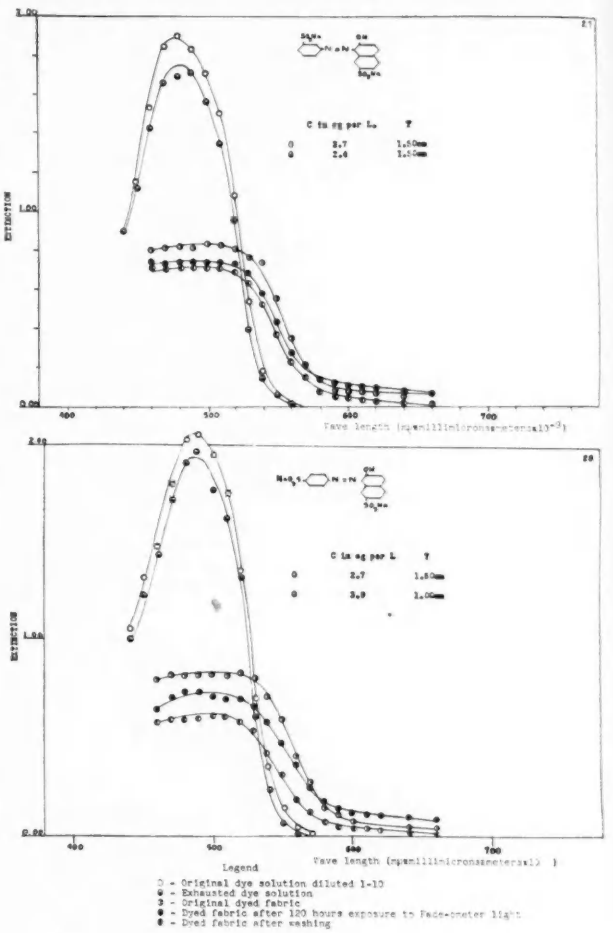


Fig. 8

in Figures 9, 10, and 11. The data in the tables was obtained from the spectrophotometric observations on the original dye solution, exhaust solution, dyed fabric, washed fabric, and light-faded fabric, and the curves in Figures 5, 6, 7, and 8 represent these five sets of observations. In the absence of special terms to indicate the usefulness or stability of the dye, it has been necessary to devise special expressions such as the utility factor. No particular claim is made for a scientific justification for such a factor, but it provides a means of comparing the relative usefulness of the dyes studied. The better the dye, the lower the factors indicated in Figures 9, 10, and 11. In Figure 9 the factors indicated are washing-fastness (W) (expressed in per cent of dye removed); fading (F) (expressed in per cent of dye destroyed as based on the drop of the maximum of the principal absorption band); darkening (d) (expressed in the increase in absorption in a portion of the spectrum having a negligible absorption in the original sample [610 mμ in the series studied]); and light fastness (L) a general light value obtained from the sum of the light fastness and darkening values. In Figure 10 the Utility values represent the sum of all of these values.

From a study of these data and an examination of the dyed and treated samples (Fig. 12) it has been possible to draw certain conclusions. For example, the ortho series in the naphthylamine dyes seems to be more uniform in their properties, whereas the ortho and para series yield poorer dyes from the 2, 3, 4, and 5 mono sulfonated alpha naphthylamine and better dyes from 6, 7, and 8 sulfonic acid derivative. The beta naphthylamine series indicates a better ortho substituted dye. In the beta naphthol series the 2-naphthol-6-sulfonic acid yields a better dye than the 2-7 acid, while in the beta-naphthylamine series the 2-7 acid appears to be better than 2-6 acid.

In Fig. 11 a comparison is drawn between similar naphthol and naphthylamine dyes. One notes, especially in the beta series a distinct reversal in the properties of the similar naphthol and naphthylamine dyes. In the naphthylamine series there appears to be a distinct increase in the washing fastness properties of the alpha series as one proceeds from the 2-sulfonic acid to the

TABLE 1—Dyeing and Fastness Properties of the Naphthylamine Series

Dye	Absorption Spectra	Exhaustion		Washing Fastness		Light Fastness			Utility Factor	
	E[a]	X[b]	E_x[c]	w[d]	W[e]	f[f]	F[g]	d[h]	L[i]	U[j]
O-∝2	1.75	460	89.1	20.9	79.1	74.6	25.4	5	30.4	140.4
M-∝2	0.92	450	75.0	3.26	96.8	90.2	9.8	15	24.8	146.4
P-∝2	0.88	500	82.8	7.7	92.3	79.5	20.5	14	34.5	171.3
O-∝3	1.10	465	90.8	35.0	65.0	74.0	26.0	13	39.0	143.0
M-∝3	0.70	460	96.1	12.5	87.5	49.0	51.0	14	65.0	217.5
P-∝3	0.84	480	95.4	6.66	93.3	66.7	33.3	12	45.3	183.6
O-∝4	0.80	470	81.9	4.68	95.4	74.7	25.3	12	37.3	170.0
M-∝4	0.80	470	89.3	1.89	98.1	63.2	36.8	14	50.8	199.7
P-∝4	0.76	480	82.3	15.5	84.5	68.2	31.8	12	43.8	172.1
O-∝5	1.01	480	79.9	20.9	79.1	70.0	30.0	15	45.0	169.1
M-∝5	0.66	480	88.2	28.8	71.2	58.8	41.2	7	48.2	167.6
P-∝5	0.74	490	91.5	5.89	94.0	63.7	36.3	12	48.3	190.6
O-∝6	1.76	480	82.7	37.1	62.9	65.5	34.5	8	42.5	147.9
M-∝6	3.68	500	97.8	36.1	63.9	78.8	21.2	12	33.2	130.3
P-∝6	1.58	500	84.3	52.6	47.4	73.8	26.2	13	39.2	123.8
O-∝7	1.52	510	78.0	29.5	71.0	65.0	35.0	10	45.0	161.0
M-∝7	1.80	500	85.6	20.6	80.0	90.5	9.5	15	24.5	129.0
P-∝7	2.10	500	86.1	41.2	59.0	81.2	18.8	20	38.8	136.6
O-∝8	1.42	510	83.1	39.3	61.0	61.5	38.5	9	47.5	156.0
M-∞8	2.00	520	94.1	50.0	50.0	70.0	30.0	10	40.0	130.0
P-∝8	2.92	520	96.3	40.5	60.0	75.5	24.5	4	28.5	117.0
O- B	0.91	480	76.00	18.7	81.3	65.5	34.5	10	44.5	170.3
M- B	1.18	460	92.55	47.0	53.0	41.0	59.0	10	69.0	191.0
P- B	1.25	470	93.15	62.0	38.0	46.2	53.8	11	64.8	164.6
O- B5	0.78	460	94.11	11.0	89.0	82.0	18.0	6	24.0	137.0
M- B5	0.70	440	70.8	10.0	90.0	68.7	31.3	11	42.3	174.6
P- B5	0.54	460	91.65	52.0	48.0	66.2	33.8	8	41.8	131.6
O- B6	0.76	465	91.50	10.2	89.8	78.5	21.5	8	29.5	148.8
M- B6	2.80	460	92.57	7.24	92.76	62.5	37.5	6	42.5	177.7
P- B6	0.84	460	87.4	17.0	93.0	70.0	30.0	12	42.0	167.0
O- B7	0.97	460	95.0	24.0	76.0	82.0	18.0	9	27.0	130.0
M- B7	0.66	460	70.0	28.4	71.6	60.0	40.0	11	51.0	173.6
P- B7	0.82	460	90.35	28.0	72.0	72.0	28.0	12	40.0	152.0

E = log $^{I_0}/_{I}$ (2.7 cg. per liter; 1 cm. cell).
X = position of band in spectra.
E_x = per cent dye absorbed by fabric.
w = per cent dye retained by fabric after washing.
W = per cent dye removed from fabric by washing = 100-w.
f = per cent dye retained by fabric after light test.
F = per cent dye removed from fabric after light test = 100-f.
d = darkening.
L = d + F.
U = Utility Factor = 2(d + f) + W.

8-sulfonic acid. In the alpha-naphthylamine series the 3, 4, and 5-sulfonic acids, which yield ortho coupled azo dyes (Type II), produce dyes of poorer quality than the para coupled (Type I) dyes.

DISCUSSION

Member: May I ask what type of spectrophotometer you use?

Dr. Brode: I have been using the Bausch & Lomb spectrophotometer. It is very satisfactory.

Mr. Connor: At the beginning of his paper the author expressed the opinion that there was no agreement as to how to express data in this field. I noticed there was no agreement in the paper. In some curves the red was at the left; in other curves it was at the right. If we subject the poor layman to such inconsistencies and expect him to understand what these curves mean, possibly we are exposing him to undue strain.

For the sake of getting spectrophotometric data better

TABLE 2—Washing Fastness Properties—Naphthol Series

No.	Dye	Absorption spectra of dye solutions: E=log.Io/I for 2.7 cg. per L. C:T=1 cm.	Absorption spectra of dye solutions: x=position of band in m_μ	Per cent of dye absorbed by fabric =Ex	Per cent of dye retained by fabric after washing=w	*W=100-w/Ex
2	O-α	2.14	472	89.4	78.6	12.2
3	M-α	2.28	470	82.0	73.4	10.5
4	P-α	2.40	471	85.0	67.5	21.0
5	A-α3	1.67	485	74.0	52.1	29.5
6	O-α3	1.12	480	88.9	69.5	21.8
7	M-α3	1.73	480	86.0	57.5	33.0
8	P-α3	0.81	490	90.0	73.5	18.2
9	A-α4	1.34	495	81.7	55.2	32.2
10	O-α4	1.33	490	87.5	73.0	16.6
11	M-α4	1.12	488	90.0	78.0	13.2
12	P-α4	1.48	495	85.1	63.8	16.7
13	A-α5	0.91	505	70.5	42.9	30.4
14	O-α5	1.01	500	89.9	89.5	10.4
15	M-α5	0.93	495	87.0	76.5	12.0
16	P-α5	1.34	500	90.0	69.0	33.2
18	O-β	1.59	480	89.1	74.0	17.0
19	M-β	1.50	480	90.2	88.0	2.5
20	P-β	2.05	480	91.0	75.5	16.7
21	A-β6	1.86	485	80.9	63.5	21.5
22	O-β6	1.11	480	89.7	73.5	18.8
23	M-β6	1.17	481	90.1	73.0	19.5
24	P-β6	1.46	480	87.0	70.0	19.6
25	A-β7	1.67	484	89.0	80.5	9.5
26	O-β7	1.19	480	87.5	68.5	21.7
27	M-β7	1.26	481	90.5	66.1	27.0
28	P-β7	1.36	489	85.6	63.9	20.6
29	A-α3:8	1.14	492	89.7	79.0	12.0
30	O-α3:8	0.96	484	96.4	76.5	20.7
31	M-α3:8	1.05	494	90.7	73.8	18.8
32	P-α3:8	0.50	498	91.2	75.2	17.6
33	A-β3:6	1.29	492	80.5	62.7	21.0
34	O-β3:6	0.80	492	96.0	84.6	11.0
35	M-β3:6	1.00	490	91.0	79.0	13.0
36	P-β3:6	1.15	495	95.2	82.5	13.4
37	A-β6:8	1.23	495	78.9	59.0	25.0
38	O-β6:8	0.81	480	89.4	64.3	28.2
39	M-β6:8	1.85	485	84.1	68.9	18.2

*W=Per cent loss of dye due to washing, based upon 100 per cent dye on fabric.

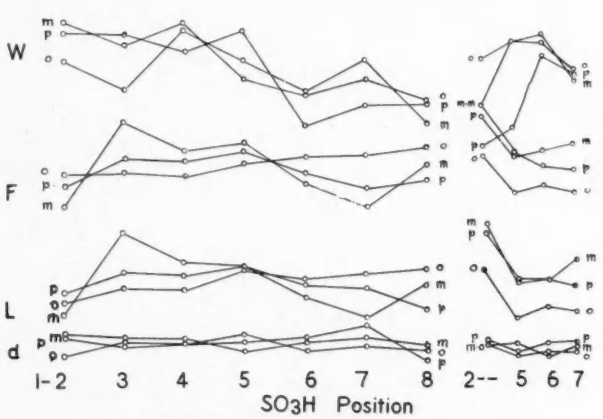


Fig. 9—Washing and Light Fastness Properties of Naphthylamine Dyes.

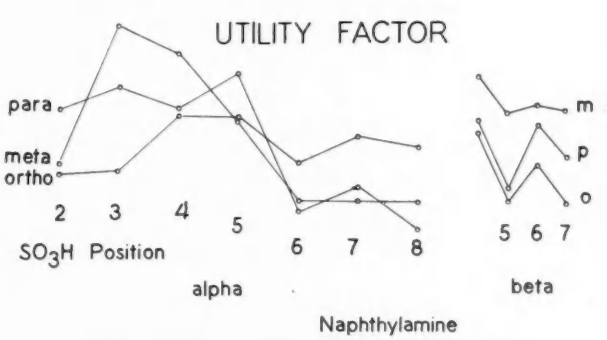


Fig. 10—Combined Effect of Light and Washing on Naphthylamine Dyes.

understood and more widely used I would like to ask the speaker if he does not think there should be some uniformity or attempt at uniformity in this respect?

Dr. Brode: Yes, I quite agree that there should be some uniformity.

I will admit that there is a variation within the paper as presented and I have always done that, apparently. I have always plotted visible color in wave length, because it seems to be more readily understood by the people who

TABLE 3—Light Fastness Properties—Naphthol Series

No.	Dye	f	F= 100-f/Ex	δ	d	D=d/Ex	L=D×F	W×L	Color of dyed fabric	Color of light faded sample
2	O-α	66.5	25.5	5	6.25	7.45	189.0	2306	Red orange	Brownish orange—high degree of fading
3	M-α ...	55.5	32.0	7	9.38	11.40	365.0	3830	Orange	Brownish orange—high degree of fading
4	P-α	75.0	12.5	0	1.00	1.17	14.7	298	Orange	Brownish orange—considerably faded
5	A-α 3 ..	66.0	10.8	0	2.55	3.45	37.2	1110	Orange	Loss of yellow—greyed
6	O-α 3 ..	83.5	6.0	3	6.40	7.22	43.2	940	Red orange	Brownish orange—no great color change
7	M-α 3 ..	75.0	12.7	2	4.90	5.70	72.5	2400	Orange	Brownish orange—high degree of fading
8	Pα 3 ...	78.0	13.0	0	6.60	7.32	95.4	1765	Orange red	Brownish orange—high degree of fading
9	A-α 4 ..	73.2	10.5	0	1.00	1.14	10.9	351	Red orange	Light orange brown—high degree of fading
10	O-α 4 ..	79.2	9.4	6	7.09	8.10	75.3	1260	Red orange	Slightly greyed—loss of yellow
11	M-α 4 ..	83.5	7.2	3	6.14	6.82	49.0	642	Red orange	Slightly greyed—loss of yellow
12	P-α 4 ...	78.0	9.6	4	2.50	2.92	28.0	523	Red orange	Greyed red orange
13	A-α 5 ..	58.0	17.8	6	7.46	9.40	168.0	5130	Orange red	Loss of yellow—high degree of fading
14	O-α 5 ..	80.5	10.5	8	9.40	7.55	100.2	1042	Orange red	Loss of yellow—greyed, high degree of fading
15	M-α 5 ..	76.5	12.0	6	6.50	7.47	89.5	1072	Orange red	Loss of yellow—greyed, high degree of fading
16	P-α 5 ..	88.0	2.2	5	4.35	4.83	10.6	353	Red	Very little change—very slightly lighter in value
18	O-β ...	83.5	6.4	3	2.90	3.24	23.8	405	Yellow orange	Very little change from original
19	M-β ...	81.5	9.6	7	6.30	6.97	67.0	168	Yellow orange	Slightly greyed—no great change
20	P-β	85.5	6.0	1	1.55	1.72	10.5	176	Orange	Very slight loss in intensity
21	A-β 6 ..	73.0	9.5	3	2.52	3.07	29.2	627	Yellow	Slightly greyed
22	O-β 6 ..	81.0	9.7	2	2.93	3.26	31.6	596	Orange yellow	Slightly greyed
23	M-β 6 .	77.0	14.0	2	3.60	3.97	55.5	1062	Orange yellow	Greyed yellow orange
24	P-β 6 ..	81.5	6.2	4	5.00	5.77	35.8	702	Yellow orange	Very little change from original
25	A-β 7 ..	83.5	6.2	5	5.00	5.62	34.8	330	Orange	Very slightly greyed
26	O-β 7 ..	81.0	7.2	3	3.11	3.55	25.6	544	Orange yellow	Very slightly greyed
27	M-β 7 ..	81.0	0.5	3	2.15	2.37	1.18	32	Orange yellow	Slightly greyed
28	P-β 7 ..	75.0	13.3	6	7.35	8.59	116.4	239	Yellow orange	Brownish orange—considerable fading
29	A-α 3:8 .	81.0	9.7	4	5.20	5.80	56.2	633	Orange	Loss of yellow—high degree of fading
30	O-α 3:8 .	88.5	8.2	5	5.75	5.97	49.0	1015	Orange	Brownish orange—considerable fading
31	M-α 3:8.	78.0	13.6	5	5.35	5.90	84.0	1580	Orange	Loss of yellow—high degree of fading
32	P-α 3:8 .	80.0	11.3	5	5.10	5.60	61.4	1082	Red orange	Loss of yellow—high degree of fading
33	A-β 3:6.	72.5	9.5	9	9.70	8.30	78.8	1592	Orange	Loss of yellow—high degree of fading
34	O-β 3:6.	87.0	8.5	5	4.75	5.00	42.5	468	Orange	Brownish orange—slightly faded
35	M-β 3:6.	82.0	10.0	5	6.04	6.60	66.0	858	Orange	Brownish orange—considerable fading
36	P-β 3:6.	86.0	9.7	6	5.85	6.15	59.6	794	Orange	Loss of yellow—high degree of fading
37	A-β 6:8.	76.0	3.8	4	2.13	2.70	10.2	259	Yellow	Very little change from original
38	O-β 6:8.	83.0	6.2	4	3.90	4.36	27.0	750	Yellow	Very little change
39	M-β 6:8.	76.0	9.6	6	6.32	7.50	72.1	1320	Yellow	Greyed—considerable fading

f=per cent of dye remaining on fabric (on basis of original solution strength) after light exposure.
F=per cent of fading or loss of dye on fabric after fading on basis of amount of dye on fabric.
δ=observed darkening.

d=darkening expressed in extinction corrected by loss of absorption due to fading of dye or $d = \frac{\delta}{Ex} f$.

D=darkening on basis of 100 per cent dye on fabric.
L=light factor or an arbitrary indication of stability of dye to light. W×L=utility factor.

work in visible color, and I have always plotted ultra-violet absorption data in frequency, and I have always plotted with lower numbers on the left and reading to higher numbers on the right. So that, since one is the reciprocal of the other. you always find red on the left in wave length and you always find red on the right in frequency graphs, and for that reason we have alternated back and forth, although I have been consistent, I think, in plotting the ordinant lower numbers on the left and higher numbers on the right.

I do agree that there should be better agreement as to the presentation of color, so that one could pick up any journal which had a curve which showed the color of a given fabric or dye and be able to read it as easily as one could read the article itself.

Dr. Draves: These dyeings were made on wool swatches. were they not?

Dr. Brode: Cashmere.

Dr. Draves: Dr. Brode, you evolved finally a utility

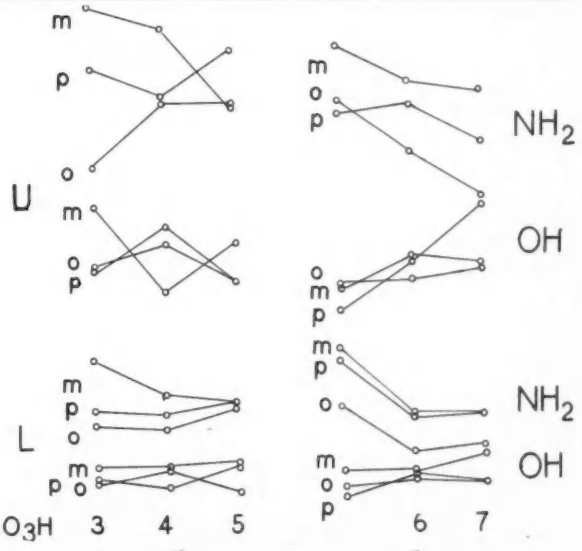


Fig. 11—Comparison of Light Fastness and Utility Factor of Naphthol and Naphthylamine Dyes

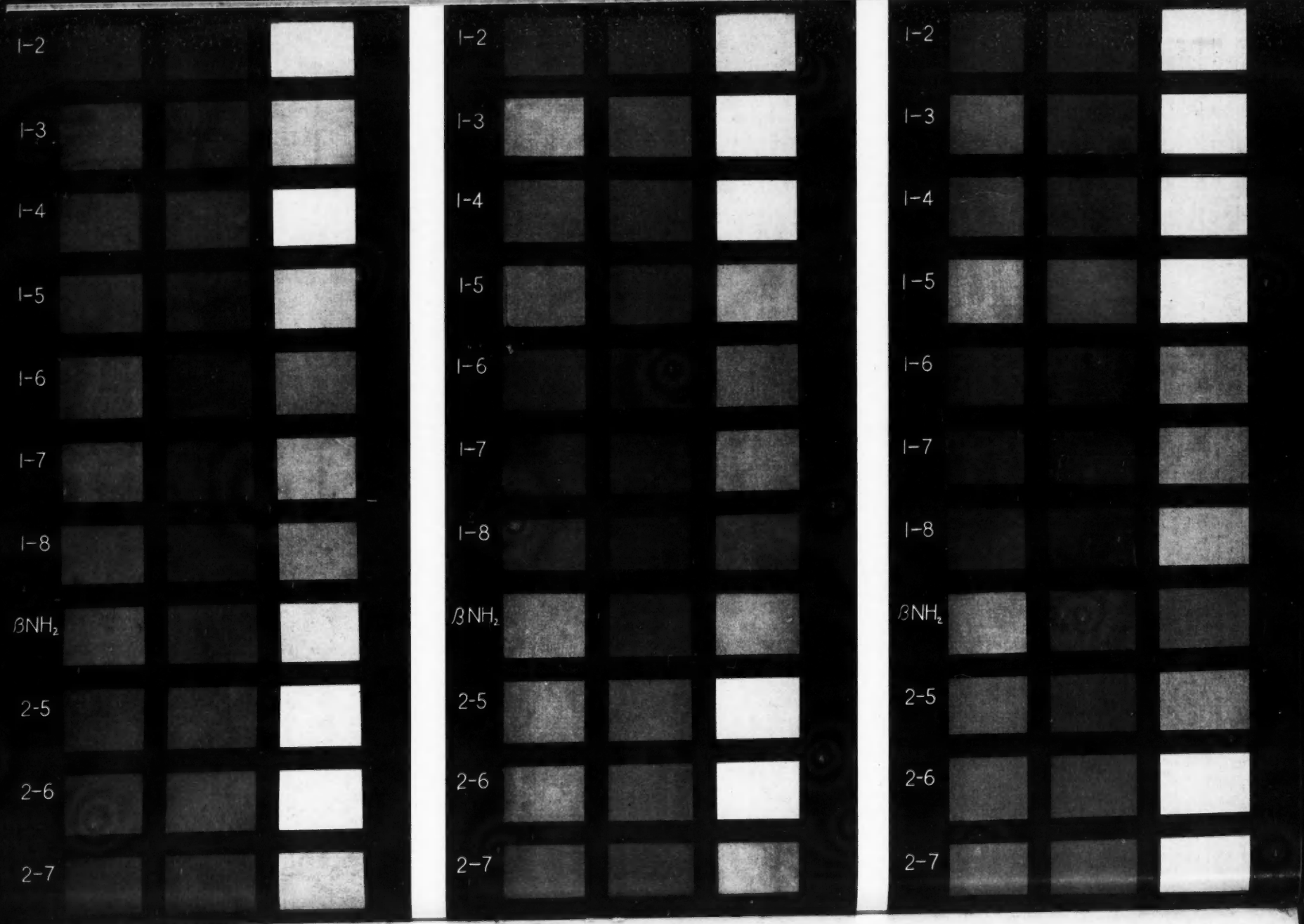

1-2
1-3
1-4
1-5
1-6
1-7
1-8
βNH2
2-5
2-6
2-7
1-2
1-3
1-4
1-5
1-6
1-7
1-8
βNH2
2-5
2-6
2-7
1-2
1-3
1-4
1-5
1-6
1-7
1-8
βNH2
2-5
2-6
2-7

Fig. 12—(Page facing)—Washing and Light Fading Test Samples; in each group the left hand sample indicates light test, the center sample the original dyed fabric and the right hand sample the washing test.

factor. Did some of the commercial dyes fall into the class where you showed a high utility factor?

Dr. Brode: Yes, Orange II falls into that class.

Mr. Manning: I should like to ask if the author has some curves of the same dye whose concentration is varied and how those curves are related to each other where the concentration does vary? I refer to reflection curves.

I have no specific data in that field on this series. I have on other dyes. I have made dyeings of different strengths in determining the reflection curves. The reflection curves do not follow directly with the concentration. There is a slight variation.

◆ ◆

Are We Making

Progress in the Textile Industry?*

A. W. BUHLMANN†

THIS is a rather broad and debatable question, but as I have chosen it as my topic, I will tackle it in a general way and not bore you with too much technical and statistical data.

Many times have I been asked: "Why has the textile industry remained so backward, compared to the steel and metal industry, automobiles, radio and aviation"—I certainly take my hat off to the automotive industry. It pays about 70% higher wages than the textile industry. The tariff on imported motor cars is 10% ad valorem, against 40% on Textile Machinery, and 30, 40, 60, even as high as 80% on textile fabrics. The American automobile has broken heavily into the markets of Europe, in fact of the whole world, while we have lost almost all our textile export business.

Is it at all justified to draw a parallel between the two? I do not think so, because we can not apply the same principles to the working up of a fiber, that we can to metal.

In the textile, the oldest industry in the world, it is not a matter of assembling parts like in the building of an automobile, but from the harvesting of the cotton, the shearing of the wool off the sheep's back, the spinning of the cocoon, to the turkish towel in your bathroom, your Tuxedo or Milady's evening gown, is a long, long step.

I have been engaged in this industry for 40 years (textile engineering is my profession), and I am acquainted with its ramifications and also know its vicissitudes.

Granting that we still utilize the cover or adornment of the sheep, the goat, the rabbit and other animals, the same old fibers, such as cotton, flax, jute and others and make a fabric out of it, as has been done for thousands of years,—yet, has not another fiber made its appearance, created by man with the aid of science?

This new chemical fiber and its phenomenal sweep, is one of the outstanding examples of progress of a new industry that has sprung up within our own old textile industry in recent years. "Rayon's 25th Anniversary," published in September 1935 in "Rayon & Melliand Textile Monthly," and "A Record of Rayons 25 years Progress" in the September 1936 issue of Textile World, will give you a concise picture, so there is no need of my elaborating on that subject.

In a letter from a University Professor out West I am asked for an explanation of the deplorable conditions in the textile industry and why it has lagged behind in rehabilitation.

Let me say here, that the word "textile" covers an immense field. In point of investment, horsepower, and value of products it is the second largest industry in the United States. Only by adding the sum total of the advancements made in its many branches can we obtain a true picture of its progress.

One can not always make one thing the measure of another and in our industry rules are continually changing.

There are so many factors combined in the successful running of a textile mill. A textile manufacturer has to be a banker, an artist, a stylist, a mechanic, a weaver, a chemist, a salesman and what not.

He has to keep in touch with the constant changes that occur in our economic life, and the thousand and one things that affect his business. A difference of a few cents a pound in the price of raw material often upsets all his calculations and changes the whole picture.

Great problems evolve very slowly, and our own observations and experiences are always too short. That is

*Presented at Saturday afternoon session, Annual Meeting, Providence, R. I., December 5, 1936.

†A. W. Buhlmann, Inc.

where the economist comes in, whose work and advice is so often belittled.

Recently I saw an advertisement of a department store, featuring transparent non-crushable velvet dinner dresses, made of Japan silk with rayon pile. Selling price of the dress—$7.95.

I can visualize a hundred million dollar investment to produce that dress.

There is the raising of the silk worm which spins the cocoon that is made into thread and shipped across the Pacific by steamer and then by rail across the Continent. There are the timberlands that supply the wood pulp to make the rayon; there is the throwing, warping, winding, weaving, dyeing and finishing, with all the machinery needed to produce the material. There are the plants for the manufacture of the dyestuffs, chemicals, soaps and oils.

The dress is then made up in the garment center of New York City,—high modern buildings, well lighted, no more sweat shops. 3000 of these garments are made up daily with a net profit of 10c on the garment.

There is the advertising and selling to distribute the dress to the retail stores all over the country.

What a story is back of that dress, more fascinating and more intricate than the building of an automobile!

We have today vastly better mechanical equipment, to make a bigger package in spinning, increased speed of warping, cutting out processes in the preparation of the yarn—automatic and thermostatic devices too numerous to mention—, arranging machinery in continuous process etc. We have adapted new alloys, stainless steel, and are making use of many other tools of science.

Much has been accomplished by cooperation, by prudent combination of educational work, proper merchandising combined with publicity and editorial support, with profitable results to everyone, which in the final analysis is what counts.

Research buildings, vocational schools, recreation buildings have been erected and a lot of progress has been made in the field of welfare work for the operative.

Someone recently said, that pure research sometimes is brilliantly useless. I am reminded of a friend of mine, who likes gay parties in company of lady friends, and does quite some entertaining. The expenses thereby occurred he lists under the heading of "charity." How he gets away with it when making out his income tax return, I do not know.

Research is "charity" in a certain sense, because the other fellow, who does not contribute toward it, gets the benefit just the same.

Snooping around in a competitor's mill or dye house to find out what he is doing, is not what I would call "research."

Taking a microscope to determine the physical fundamentals of a fiber and its dynamic properties is real research.

Just as it took years and years to find out what causes the knocking of the gasoline in the motor and to develop substances to prevent the knocking, so must we take advantage of the findings of pure research, analyze these findings and adapt them to the various phases of manufacturing, if we want to make advance.

If you do not like the word "research," I have a substitute for it; the word is "analysis," and I believe in it 100%. Unlimited possibilities lie before us, if the textile chemist and the textile engineer work and analyze together.

You have heard of the Rust mechanical cotton picker. I was in Tennessee, Arkansas and Mississippi a few weeks ago, and saw this picker. The spirals on a conveyor are automatically moistened and the open cotton is stripped off the plant, adheres to the rotating spindles, is stripped from the spindle and delivered by suction to a container.

By a peculiar coincidence, this cotton picker has 1,344 spindles, just like a fine index Jacquard machine, which has 1,344 hooks. Joseph Marie Jacquard obtained his first French Patent December 26th, 1801. A few years later, in Lyon, the great French silk city, some weavers, afraid of losing their job, broke into his workshop, removed his first original machine, took it to the City Hall Square, demolished it and burned it up. Mr. Jacquard himself, on his way home, was seized by the angry mob, who tried to throw him into the river Rhone, but fortunately he made his escape.

One of the Rusts is now in Russia, demonstrating his machine, and the other, who lives in Memphis, may do well to watch out. His picker can do the work of 50 to 100 hand pickers, and they may get after him. The Mississippi River is right near by.

This mechanical picker is a robot. It has the fundamental features of greatly increased speed and greatly reduced cost of harvesting, and its present defects will no doubt be overcome.

Speaking of inventions, are they a criterion of progress? If so, where do we stand on that score?

I will give you some data, obtained from my friend Oscar A. Geier, the well-known patent attorney.

During the last twelve months, the U. S. Patent Office has issued approximately 600 Patents in the textile field, such as spinning, doubling, winding, weaving, sizing preparations, bleaching, dyeing, printing, finishing, etc. This figure would indicate that in 12 months approximately 1,200 textile patents have been filed, as only 40 to 50% of all applications filed in the U. S. Patent Office become patents.

This is a pretty fair average compared to other industries, if we take into consideration that many improvements and inventions are kept in the mill, dye house or finishing plant. and never reach the outside.

Furthermore, about 800 patents have been allowed in the U. S. Patent Office for textile fabric designs. Approximately 600 trademarks for yarns and textile fabrics in general have been issued during the past twelve months.

In trademark and design protection we are quite ahead of all other industries.

In conclusion, and whether, a vindication of our industry might or might not be in place, is it not true that a change does not mean progress. We can change many things, but by doing so, we are by no means always better off.

In the complexity of textile manufacturing, the creation of one new machine does not bring a general uplift. Improvement of the whole machinery all along the line has to be in step and has to balance. If it does not, we simply are compelled to adhere to established, proven and tested equipment.

In buying a new car (c-a-r), you want next year's model, streamlined, of course. In buying a new card (c-a-r-d), it is not unlikely that you will want "exactly what you had before"—never mind the streamlines!

The rehabilitation of the textile industry, is on the way. Increased earnings, so visible in the latest financial mill statements seem to indicate it. The biblical lean period is over, and brighter days are ahead.

We have men of initiative and vision in the Textile, like in any other industry.

If I am again asked: "Why is it, that this great industry of ours has not produced an Edison, a Ford or a Lindbergh," my answer will be: "Should the need for a master mind to guide the destinies of our most ancient craft really become acute, a genius will appear at the right time. He may be found right among you Gentlemen of the American Association of Textile Chemists and Colorists."

The Chemistry of the

Stabilized Azoic Colors*

HERBERT A. LUBS†

VIEWED in retrospect, this development has not been particularly spectacular, but rather a gradual evolution in which hundreds of chemists participated, each in succession using the building stones fashioned by his predecessors. It illustrates again that when the urge is sufficiently great, or when new needs or conditions arise, the chemists can usually produce materials to meet the demands, and it further shows how devious may be the paths to attain the same objective. We have here also a case where valuable ideas have lain fallow for many years before being practically utilized.

For the purposes of this discussion, the stabilized azoic dyes may be defined as a mixture of a soluble stabilized aromatic diazo compound and a secondary component with which it can couple under suitable conditions to form an insoluble colored pigment. The writing of this interesting chapter in dyestuff history actually began with the inestimably important discovery by Peter Griess, in 1860, that by the action of nitrous acid on aromatic amines, diazo bodies were produced which gave colored substances upon reacting with phenolic or amino bodies. The next important step in this evolution was made in 1880 by Read Holliday by the introduction of a method for the production of insoluble pigments on cotton goods by padding with β-naphthol and subsequently passing the material through diazotized β-naphthylamine. Some years later Hoechst and Badische extended this idea to a wider variety of shades by utilizing other bases particularly p-nitro aniline for the production of para red.

Although the preparation and properties of β-oxy naphthoic acid anilide were described by Schöpff in 1892, it was not until 1912 that materials of this type found application in the dyestuffs field when the Naphthol AS series were introduced by Griesheim-Elektron.

Methods of stabilizing diazo bodies by their conversion into "nitrosamines" or anti-diazolates were patented in 1893[1], but patents covering mixtures of nitrosamines and various oxy naphthoic acid anilides suitable for printing did not appear until 1914[2]. These mixtures were offered on the market as the "Rapid Fast" or "Pontagen" colors, and were of great assistance to the printers, particularly for the production of fast orange, red, and scarlet shades.

The "nitrosamines" are prepared by the action of strong caustic on diazo bodies, and the number of aromatic amines from which suitable "nitrosamines" can be prepared is extremely limited.

Dyestuffs chemists soon realized that if the range of printing colors of satisfactory shades was to be extended, it would be necessary to find other means of producing

*Presented at Saturday afternoon session, Annual Meeting, Providence, R. I., December 5, 1936.

†E. I. du Pont de Nemours & Co., Inc.

[1]U. S. P. 531,973, 531,974, 531,975, 531,976, 531,977.

[2]U. S. P. 1,193,566.

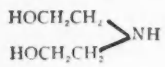
stabilized diazos. As a result, intensive work was initiated along this line, both in this country and abroad, with a result that there is now available to the cotton printer a fairly wide range of colors of excellent general fastness variously known as the "Diagens," "Rapidogens" and "Pharmasols."

A suggestion of a means of stabilizing diazos was offered by Bäyer in 1875[3]. He found that diazo bodies combined with aliphatic amines to produce stable, insoluble bodies usually of an oily nature. Their insolubility in water or printing gums rendered them useless so far as printing is concerned. This handicap, however, was soon overcome by the almost simultaneous discovery in America and Germany of methods of obtaining soluble compounds of this type which are stable in neutral or alkaline solution, but regenerate an active diazo body which simultaneously couples with a β-oxy naphthoic acid anilid or other suitable coupling component.

Another significant observation was made by Griess as far back as 1866 that aromatic diazo bodies reacted with M-amino benzoic acid to produce water soluble diazo amino compounds[4]. Hence we see that the more fundamental scientific information necessary for the development of this group of printing colors was available before 1900 but it required about 30 years for its technical utilization.

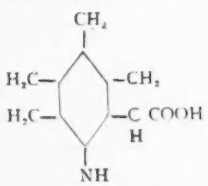
The more important and useful compounds for the production of stabilized diazos for use in preparing the stabilized azoic dyes are:[5]

(1) *Diethanol amine*

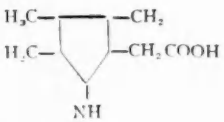


(2) *Sarcosine*

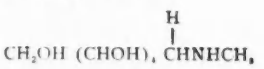
(3) *Pipecolinic acid*



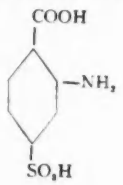
(4) *Proline*



(5) *Methyl glucamine*



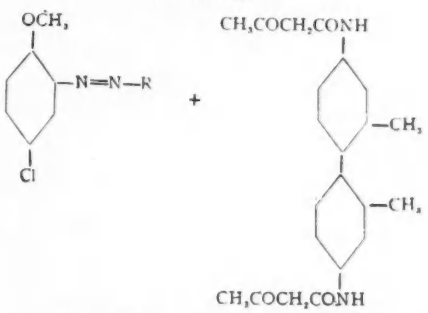
(6) *2-amino-4-sulfobenzoic acid*



The origin of these stabilizers will possibly be of interest to you as they illustrate very nicely the diverse directions in which chemists travel to achieve an end result. Diethanolamine needs no discussion as it is a commercially available material made by the action of ammonia on ethylene oxide or ethylene chlorhydrin. Sarcosine is easily prepared by the action of methylamine on chloracetic acid by the replacement of a labale halogen. Pipecolinic acid, however, requires more effort in that 2 methyl pyridine must first be oxidized to picolinic acid which is then catalytically reduced to pipecolinic acid. When proteins such as glue or albumen are completely hydrolyzed to their building stones by means of acid or alkali, about ten per cent of the hydrolysis mass consists of proline which can be separated out by certain precipitation reactions. Methyl glucamine is an interesting material, in that it is prepared by the condensation of ordinary glucose with methyl amine, and the product so obtained then reduced by hydrogen in the presence of a suitable catalyst.

By means of the afore mentioned bases a wide variety of stable diazo bodies can be produced which when mixed with suitable coupling components provide the cotton printer with a fairly complete range of reasonably fast shades ranging from yellow to black. The following examples will illustrate some of the combinations which have proved of practical importance for the production of a range of desirable shades:

*YELLOW**

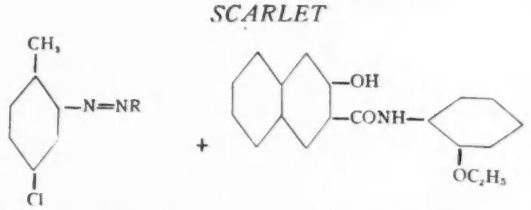


4 *Chloro-2-amino anisole* — *Diaceto acetyl tolidine*

ORANGE

2-5 *Dichloraniline* — *o-Toluidide of β-oxy naphthoic acid*

SCARLET

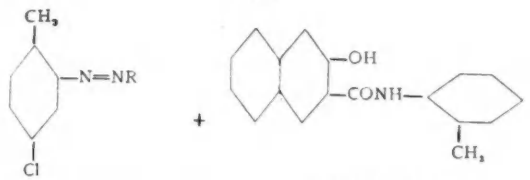


4 *Chloro-2-amino toluene* — *o-Phenetidide of β-oxy naphthoic acid*

[3]Ber. d. Dent. Chem. Ges. *Ber. 8*, 148,893.
[4]Ann. *137*, 62.
[5]U. S. P. 1,882,562, 1,982,681, 1,968,878.

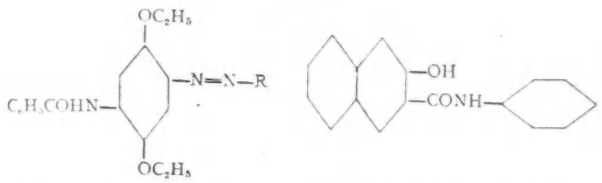
*In this and the following formulae R represents one of the previously described stabilizers. Under each stabilized diazo body is given the aromatic base from which it was derived.

RED



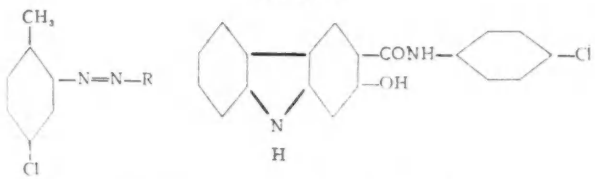
4 *Chloro-2-amino toluene* — *o-Toluidide of β-oxy naphthoic acid*

BLUE



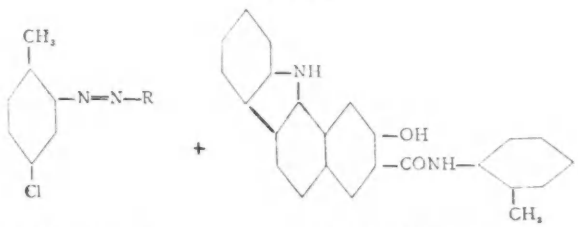
4 *Benzoyl amino 2-5-diethoxy aniline* — *Anilide of β-oxy naphthoic acid*

BROWN



4 *Chloro-2-amino toluene* — *p-Chloro-anilide of 2-hydroxy-carbazole-3-carboxylic acid*

BLACK



4 *Chloro-2-amino toluene* — *o-Toluidide of 7-hydroxy-a-naphtho carbazole-6-carboxylic acid*

These represent but a few of the available colors which have been selected as a result of many thousands of experiments in numerous laboratories to develop a range of shades embracing the maximum of fastness or brilliance combined with good working properties at a reasonable cost. In the foregoing examples there was not included a green. Such a combination has been available, but its use has been negligible, largely because of its poor shade. Fortunately this deficiency can be overcome by the use of the solubilized leuco ester of jade green alone or shaded with one of the stabilized azoic yellows. Although various individual browns are available, for reasons of economy many printers prefer to produce such shades by mixtures, usually of a yellow, blue and orange or red. In this connection, it may be mentioned that when these colors were first introduced there was some disappointment and surprise amongst printers when attempts were made to obtain greens by mixing yellows and blues and there resulted instead various shades of brown. This phenomenon obviously was due to cross coupling between the several stabilized diazos and coupling components.

In the experimental demonstration which is about to follow, the necessity of a judicious selection of the stabilizer will be evident. It must be of such a nature that the diazo body will not decompose or combine with the coupling component upon prolonged storage or in the printing gum before the printed goods are aged. The stabilized or inactive diazo body must be capable of regeneration into the active form at an acid concentration not too high to inhibit coupling. The several phases in the development of a stabilized azoic color can be illustrated by the addition of mineral acid to a stabilized azoic solution. The stabilized diazo is thus transformed to the active form but the hydrogen ion concentration is so high as to inhibit the coupling. Addition of the proper amount of a buffering material such as sodium formate or sodium acetate lowers the hydrogen ion concentration to the point where quantitative coupling can be obtained. In practice the printed goods are developed by passage through an ager containing steam and a mixture of acetic and formic acid vapors whereby the proper condition of temperature and acidity is obtained for the regeneration of the active diazo and its simultaneous coupling.

In the selection of components for mixtures to produce the various shades there are a few guiding principles. When a yellow is desired the coupling component is selected from the group containing an active methylene group capable of tautomerizing, such as an aceto acet anilide derivative. When the coupling component is a naphthoic acid anilide derivative, variation in the substituents of the diazo body has in general more effect on shade than variation in the substituents of the former. The use of negatively substituted diazo bodies such as those containing the halogen or nitro groups results in orange or scarlet shades, while positive substituents such as alkyl, alkoxy, or acylamino groups yield bordeaux to blue shades. In the case of the reds, the diazos usually contain both negative and positive substituents. Browns require a marked change in the nature of the coupling component such as the substitution of a carbazole for a naphthalene nucleus.

We have not yet attained the final development in this field. Work is still in progress and we can confidently expect newer and better colors. Though they have, and are still serving a useful purpose for the cotton printer, especially for the production of red, yellow, scarlet, and brown shades of reasonably good fastness at a moderate cost, yet for the ultimate in fastness they do not in general attain that possible by the use of properly selected vat dyes.

REPORT OF THE DELEGATES REPRESENTING THE AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS ON THE INTER-SOCIETY COLOR COUNCIL FOR 1936

THE Inter-Society Color Council has been functioning actively under its new Articles of Organization and Procedure during the past year.

Four News Letters, carrying some ninety-three pages, were issued to the members. These contained items of color interest, abstracts of many papers on the subject of color, notations regarding commercial color specifications, and references to color standards that have been adopted.

The Annual Meeting of the Council was held at the Waldorf-Astoria Hotel on February 20, 1936. At the conclusion of the business session, three lectures were given on the Chemistry of Color, Color as Light and Color In Use. There were between five and six hundred in attendance.

Members of the Council located in and near Washington, D. C., have formed a group known as "The Colorists" which holds meetings monthly. With the help of the Council, a second group was formed in Chicago under the name of "Association for Color Research".

A Conference on Color was held at Massachusetts Institute of Technology, July, 1936, and members of the Council were called on to present papers dealing with the following subjects: Color problems in the textile industry; the inter-relationship of the various aspects of color; colorimetry in the dyestuffs industry, with special reference to fastness testing; computations involving the standard observer; specification of whiteness; the solution of grading problems by the use of a disk colorimeter; artificial daylight and its application in colorimetry; the Munsell system of color specification; the accuracy of spectrophotometric measurements; specification of the colors of railway signal glasses; the standard observer in colorimetry; color tolerances in terms of material standards; the specification of the whiteness of paper; the optics of pigmented films; the industrial significance of color measurements; and, tolerance in color specification.

The Council's Committee on Problems has found it necessary to set up various sub-committees to properly handle the different matters that are brought to its attention. Those projects holding general interest are as follows:

Project No. 5—Compilation of "Who's Who in Color".

Project No. 6—Survey of color terms—that have been officially adopted by technical societies and associations, or which, through general use, have become well-recognized in industry.

Project No. 7—Survey of color specifications, that have been adopted by technical societies and associations, or which are in commercial use.

Project No. 8—Survey of color problems that are of broad interest and have been brought before national societies and associations for consideration.

One of the original projects referred to the Council by the National Formulary Committee of the American Pharmaceutical Association, requested a new system for naming the colors used in the United States Pharmacopoeia. Such question of color nomenclature is complicated by the fact that there are 100,000,000 distinguishable colors, of which some 10,000,000 are producible by dyes and pigments, and for which, in the present U. S. P. system, there are only some 500 color names. Each name, therefore, referred to a range of color rather than to a single color. After consideration, the Council's Committee on Measurement and Specification developed a new system of color naming, for use by the U. S. P., that will provide a definite, accurate measure of color strength and tone. The new color names are simple, easily understood, and usable, and are based on a logical, scientific system which gives them a legal standing, making them available for many types of analytical work. The system is based on the use of such terms as red, green, blue and purple, with the component hues orange, pink, brown and olive. The modifiers are faint, pale, light, brilliant, weak, vivid, strong, dusky, dark and deep, together with the adverb *very*. The resulting terms, such as "very dark blue," would relate to a definite standard of color, rather than to the color education of an individual observer as has been the case. Indefinite names ending in "ish", such as reddish, yellowish, etc., have been eliminated, except as modifiers of definite names, such as reddish purple, yellowish green, etc.

The fundamental method of applying the new system of color names, consists of measuring the spectral reflectance of the substance under study, computing the tristimulus specification of it, and deriving the color name from this data. In actual usage, however, reference standards such as the Munsell Book of Color may be used for visual comparison, which with practice, takes only from one to five minutes. Standardizing laboratories may apply the more fundamental method in cases of dispute or legal demands.

In order to put this new system into effect, research is being conducted at the National Bureau of Standards, under the direction of Dr. Deane B. Judd of the Bureau's staff, who is Vice-Chairman of the Council, and by Mr. Kenneth L. Kelly, research associate, under a National Formulary research project of the American Pharmaceutical Association which is sponsoring the work as a means of standardizing the color names used to describe official drugs and pharmaceuticals used in the treatment of disease. Many changes in official standards for drugs have already been recommended as a result of the research to date.

In general, the Council does not initiate its own problems, nor endeavor in all instances to provide their solution,

but instead, seeks to bring together the individual or technical group having the problem, with some person qualified to provide its solution.

The delegates representing the A. A. T. C. C. have been active in the affairs of the Council. Walter M. Scott is Chairman of the Membership Committee and is a member of the Sub-Committee on "Who's Who in Color." William D. Appel is in charge of a survey of color terms and of color problems in the textile industry.

Delegates: WILLIAM D. APPEL
CARL Z. DRAVES
WALTER M. SCOTT

December 31, 1936.

—♦♦—

Textile Color Terms, Specifications and Problems

WHAT words are used in the textile industry to describe colors and color differences? What do these words mean? What specifications relating to color are generally recognized and used in the industry? What are the important textile color problems?

The Sub-Committee on Color Standardization of the Research Committee, American Association of Textile Chemists and Colorists, desires your help in answering these questions. Tentative answers have been prepared from the statements of a few dyers and dye chemists. They are printed below as a basis for your consideration. Your criticism of these answers and your suggestions for improving or adding to them will be appreciated. Please send your communications to Dr. Walter M. Scott, Chairman, Sub-Committee on Color Standardization, 857 Boylston Street, Boston, Mass., or to W. D. Appel, member of the Sub-Committee, National Bureau of Standards, Washington, D. C.

The purpose of this survey is to focus attention on the present color nomenclature and problems of the textile industry. It is hoped thereby to stimulate interest in these subjects and to promote a better understanding of them.

If there is sufficient interest in these subjects it may be possible by concerted effort to develop a generally acceptable uniform system of describing colors and color differences and to solve some of the outstanding color problems.

This work was started by the Research Committee at the request of the Inter-Society Color Council of which the A.A.T.C.C. is a member. Similar surveys are being made in other organizations, for example, the Technical Association of the Pulp and Paper Industry and the Optical Society of America. A comparison of these surveys will be of interest to all of the organizations represented.

COLOR TERMS

Color terminology has not been formally developed in the textile industry and there is no "official" set of terms. The following terms are rather commonly used in the sense indicated. It should be noted that the textile dyer is concerned not so much with describing colors as such as with comparison of dyeings which should match in color but which may vary slightly, and with describing colors from the standpoint of the dyeing operations. The textile dyer and colorist often means "dye" when he says "color."

Barry—streaked.

Bloom, bloomy—having the appearance of depth.

Blotchy—irregularly spotted.

Blurry—having uncertain outlines.

Bright—brilliant, vivid (see dull).

Brightness—the brightness of a color is its vividness (spectral purity), usually relative to some other similar color with which it is being compared.

Bronzy—having a metallic (usually yellowish, greenish or reddish) surface appearance that partly obscures the color of the body of the material.

Clean, clear—free from a tendency to be dull, dingy, grey or cloudy in appearance.

Cast—tendency toward, as "green cast," "red cast."

Crocking—rubbing off.

Dark—having the appearance of reflecting only a limited amount of light (see shade).

Dingy—having a dull or cloudy appearance.

Downhand—viewed with the line of vision at an acute angle to the surface.

Dull, dullness—the opposite of bright or vivid; cloudy.

Even—uniformly colored over the surface.

Fast—will not fade or change in color on exposure to some named or implied agency, like light or laundering.

Flat—having the appearance of a non-lustrous diffusely reflecting or matte surface.

Full—further additions of the dye will not change the color materially, as "full shade."

Gray—one of the series of colors between black and white, which have little or no hue, i.e., are not red, yellow, green, blue, violet, etc.

Grey—(sometimes "greige" when applied to silk textiles) not a color term. A textile as it comes from the loom or knitting machine before it is subjected to wet processing is said to be "grey" or "in the grey condition."

Hungry—exhibiting that dullness or weakness of color characteristic of dyeings in which the dye has been deposited on the surface of the fibers rather than throughout them.

Jet—a black resembling the color of black velvet, which is free from bronze and any tendency toward reddish, greenish or other hue.

Light—having the appearance of reflecting much light (see shade).

Mealy—finely blotched.

Medium—used to designate a color intermediate in appearance between one which would be obtained by using a small amount of the dye and one obtained by using a considerable amount of the dye (see shade).

Off-shade—a color which does not match the standard.

Overhand—viewed with the line of vision more or less perpendicular to the surface (see downhand).

Spotty—non-uniform over small areas.

Strength—the strength of a dyeing is the amount of dye introduced in the dye bath to dye a given amount of material, usually expressed as a percentage of the weight of the material.

Strong—a comparative term used to indicate that one dyeing has the appearance of having been dyed with more dye than the other. One dye is said to be stronger or to have greater strength than another if a given weight of it will dye more material to the given color than the same weight of the other dye.

Shade—(1) same as "color," as: "dyed shade"; "printed shade"; often used to designate a color not greatly different from some particular color under discussion, as a lighter, yellower, or more vivid shade. (2) Shade is a term expressing any variation in color not attributable to variation in strength of dyeing. The "shade" of a green is commonly described as yellow or blue, light or dark, bright or dull; of a red as yellow or blue, etc.; of a yellow as green or red, etc. Sometimes "shade" relates only to hue or spectral character. Sometimes it relates also to brightness. The "shade" of a dyeing is the shade of its color and the "shade" of a dye is the shade of the color of dyeings made with it.

Thin—same as weak, the opposite of strong.

Tinctorial power—the effectiveness of a given weight of dye in dyeing a given weight of material.

Tone—hue or spectral character of a color.

Weak—the opposite of strong, which see.

COLOR SPECIFICATIONS

The colors of textiles are generally specified in general non-technical terms or else by reference to a standard sample of material of the desired color. The color cards of the Textile Color Card Association of the U. S. A., Inc., are commonly used as a basis of reference.

Federal Specification TT-C-591 "Colors; (for) American Flag" is applicable to bunting purchased by the Federal Government. This specification requires that the colors shall match the colors of standard samples when inspected under carefully prescribed conditions. The colors of the standard samples are recorded in terms of trichomatic coefficients (I.C.I. system) derived from spectrophotometric measurements.

Federal Specification T-R-601 for "Rope; Manila" includes requirements for the "Becker" value or "per cent reflection of the fiber sampled, prepared, and measured under" carefully prescribed conditions.

The fastness of the color of a textile or ability of the textile to withstand external agencies and not to fade is specified by means of fastness tests. Standard fastness tests are provided in the 1935-6 Year Book of the American Association of Textile Chemists and Colorists. Standard dyed cotton, wool and silk fabrics representing the different degrees of fastness to washing have been prepared by this association for sale at a nominal price. The kinds of fastness covered and the language used in some of the tests to specify or describe color changes are given briefly below.

Fastness tests for dyed or printed cotton:

To laundering and domestic washing; "samples that stand test No. — without material alteration in shade or staining of white cloth are considered fast . . ."
To fulling; "shade unaltered"; "shade not altered or only slightly so."
Fastness to chlorine; "color shows a distinct loss in strength or change in shade"; "color shows no loss in strength or change in shade."
Fastness to stoving; "shade changed considerably"; "shade slightly changed."

Fastness tests for dyed or printed rayon:

To laundering and domestic washing.

Fastness tests for dyed or printed silk:

To washing of dyestuffs on silk: "note alteration in color and staining of . . . "; "no greater alteration in color than the standard for this class in tests Nos. . . ."
Laundering or domestic washing; "no appreciable alteration . . ."
To fulling; "colors in this group show a noticeable

alteration," "very slight alteration," "without noticeable alteration."

To degumming of dyed silk; "greater alteration in color than the standard."

To stoving of dyed silk; "depth and shade changed," ". . . slightly changed," "not changed."

To peroxide bleaching of dyed silk; "no appreciable alteration in color."

Fastness tests for dyed wool:

To laundering and domestic washing of dyed woolen material; "dyeings of these colors . . . show an appreciable change"; "no greater change than . . .", "practically no change."

To fulling, scouring and mill washing.

To dry and wet heat; "shade changes and does not return to original," "shade changes but returns to original," "no change in shade."

To stoving: "shade changed considerably," "shade changed only slightly."

Fastness to perspiration.

Fastness to light.

Fastness to acids and alkalies; "change in shade is noted," "not altered," "slightly altered," "distinct alteration."

Fastness to carbonizing.

Fastness to sea water.

Fastness to crocking.

The American Society for Testing Materials has tentative standard methods for:

Fastness of dyed or printed cotton fabrics to laundering or domestic washing, A.S.T.M. designation D435-36T.

"The color of the test specimen shall be compared by eye with the color of the corresponding unwashed specimen. In making the comparison, the specimens shall always be held parallel to each other and viewed at the same angle under a standard daylight lamp or equivalent illumination." "The fastness of the specimen shall be determined by a comparison with the fastness of a standard dyeing tested in the same way and at the same time."

Fastness of dyed or printed silk or rayon fabrics to laundering or domestic washing, A.S.T.M. designation D436-36T.

Commercial Standard CS-59-36 "Woven dress fabrics. Testing and Reporting" provides standard methods of testing and reporting color fastness to crocking (rubbing), cleaning (dry and wet), dry pressing, laundering and light.

"The color of the . . . specimen is compared with that of the original fabric . . ." "The color fastness may be determined by a visual comparison with the fastness of the standard dyeings tested in the same way and preferably simultaneously.' "The color fastness of a fabric shall be reported as 'comparable to standard sample . . .'"

Federal Specification CCC-T-191 for "Textiles; test methods" contains the general methods of test applicable to Government purchases of textiles. Tests are given for color fastness to light; weather; laundering (washing) of materials containing wool, silk, or rayon; water; salt water and soap; crocking; perspiration.

"When no standard sample has been established, the tested specimen shall be compared with the original material and rated on the following basis:

"Good: No appreciable alteration of color.

"Fair: Appreciable but not objectionable alteration of color.

"Poor: Objectionable alteration of color.

"The judgment of the inspector may be aided by comparison with the material from former satisfactory purchases if these are available. Such material should be tested at the same time and in the same way as the material to be graded.

"When a standard sample has been established, specimens from the material to be graded and from the standard shall be tested simultaneously and in the same way and rated in fastness on the following basis:

"Satisfactory: Equal or superior to the standard in fastness.

"Unsatisfactory: Inferior to the standard in fastness."

COLOR PROBLEMS

The textile industry is concerned with dyes, their evaluation for use on textiles, the dyeing and printing of textiles to obtain given color effects, the properties of the dyed and printed products in storage, use, laundering, and cleaning. A long list of important problems relating to the production and use of textiles whose appearance and color depends upon bleaching, dyeing, printing, lustering, delustering, and similar treatments could be given. In so far as these *dye* and *textile* problems are concerned with color per se, they involve the problems of: (1) describing color appearances found in textiles, (2) measuring colors accurately and yet rapidly, (3) evaluating differences between similar colors and changes in colors, (4) evaluating whiteness, luster, bronziness, bloom, and the like.

CLOTH FOR CROCK METER

Squares of bleached white cotton cloth of the exact size and specification recommended in the 1935-36 Year Book for use with the Crock Meter are ready for distribution at the following prices:

Packages of 100.....$ .20 postpaid
3 packages ..... .50 postpaid
7 packages ..... 1.00 postpaid

(Smaller amounts may be paid for in United States postage stamps). They may be obtained from L. A. Olney, Lowell Textile Institute, Lowell, Massachusetts.

CALENDAR OF COMING EVENTS

Meeting, New York Section, Swiss Chalet, Rochelle Park. N. J., February 26, 1937.

* * *

Meeting, Philadelphia Section, February 26, 1937, Penn. A.C., Philadelphia, Pa.

* * *

Annual Meeting, Midwest Section, Bismarck Hotel, Chicago, Ill., February 27, 1937. Preceding the dinner will be a round table discussion presided over by Herman Boxser. Dr. R. E. Rose, du Pont Company, is the speaker of the evening and will address the Section on "The Problems of Dyestuff Control." Election of officers will be held following the dinner.

* * *

Spring Meeting, Piedmont Section, King Cotton Hotel, Greensboro, No. Carolina, April 17, 1937. The Council will also meet there on the morning of the same day.

MEETING, NEW YORK SECTION

THE third regular meeting of the New York Section was held on Friday, January 29th, 1937, at the Swiss Chalet, Rochelle Park, N. J., at 8:00 P. M. The usual informal dinner was held at 6:30 P. M. preceding the meeting.

Dr. H. H. Mosher of the Onyx Oil & Chemical Company spoke on "Chemical Aspects in Finishing Rayon Crepe" and Dr. J. E. Meili of the Sandoz Chemical Works presented a paper on "Saponification of Acetate Rayon." The usual open discussion followed immediately after the presentation of these papers. The guest speakers were extended a rising vote of thanks.

Among the guests were several members from out of town sections.

There was a total attendance of one hundred and fifty-one (151).

Respectfully submitted,

P. J. KENNEDY, *Secretary*.

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary or the American Dyestuff Reporter any vacancies which may occur in their businesses.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE.
Prospective employers may file vacancies either with the secretary or the American Dyestuff Reporter.

A-1

Education—B.T.C., Lowell Textile Institute.

Experience—Two years as chief chemist in cotton mill. Experienced on direct, vats, naphthols, sulfur, basic and developed colors. Two years' experience in protein, fat fiber and mineral control in grains and animal feedstuffs. Age 28.

A-B-1

Education—Graduate chemist and colorist from a leading textile institute. Speaks French fluently. High standing at school. Awarded 1st prize in chemistry. Member of honor society.

Experience—Knowledge of most processes of textile manufacturing and some experience in woolen and worsted piece and stock dyeing and color matching. Presently employed in other department but wishes to get into laboratory or dyehouse.

A-B-5

Education—Graduate of the University of Lausanne, Switzerland. Doctor's degree in Chemistry. Knowledge of French and German.

Experience—Eleven years with large bleaching, dyeing, printing and finishing plant as assistant Chemist and then Chemist in charge of the Laboratory. Experience in dyeing and printing cotton and rayon fabrics; research and analytical work. Woman.

A-B-7

Education—Evening school in textile dyeing.

Experience—2 years laboratory in dyehouse; 9 years dyer and foreman on hosiery, ribbons and rayon; 2 years assistant to superintendent. Can handle help efficiently. Desires position as supervisor or demonstrator of dyestuffs. Age 30; married. Prefers vicinity of New York.

A-B-C-1

Education—B. S. in Chemistry, Massachusetts Institute of Technology.

Experience—7 years with a prominent worsted mill as assistant chief chemist, chief chemist, and superintendent of dyeing and wet finishing. Thoroughly familiar with chemical problems of worsted industry. Age 33; single. Location unimportant.

A-B-C-2

Education—Graduate of Lewis Institute of Engineering of Chicago and graduate of Philadelphia Textile School (Chemistry and Dyeing department).

Experience—Has had extensive experience as assistant chemist and colorist in silk printing, dyeing and finishing; also dyeing raw stock wool; and dyeing and finishing cotton and rayon. Age 30; married; references.

A-B-C-3

Education—Graduate, Chemistry and Dyeing Course, Lowell Textile Institute, 1934.

Experience—Has experience as chemist; dyer of union knit goods (cotton and woolen); experienced bleacher on both. Has handled Tube-Tex processing on cotton and rayons. Single; will go anywhere.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following: celanese, rayon, cotton backs, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-4

Experience—Foreman dyer in charge of ribbon dyeing for 20 years. Experienced on silk, cotton, rayon, acetate yarn. Age 41; will go anywhere.

B-F-1

Experience—As executive had charge of the dyeing of ribbons and piece goods for 6 years; spun silk yarn, fast and resisted dyeing for 8 years; hosiery for 12 years. Has been quite successful in all three of these mills. Age 50 married. Will go anywhere.

AMERICAN
DYESTUFF REPORTER

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CONSUMERS PAY TRIBUTE

THE great complexity of the economic process today often leads to inconsistent conflicts and inconsistent alliances. The struggle between employers and those who would raise wages above the point fixed by market value is regarded by the ignorant public as exclusively a fight between "capital and labor." Hence, the great masses of consumers give their support to "labor." As a matter of fact this is fundamentally a struggle on the part of an organized group of workers to place an unwarranted and unjust burden on consumers in order to obtain a bonus for themselves.

On the open market of freedom of contract, the market, not individuals nor groups, fixes the values of all commodities and all services. The value or price is the result of natural forces expressing themselves through the natural law of demand and supply and the natural law of competition. The fact that here and there individual exceptions may be found to this law does not materially affect its general applications.

Differences in wages on a constitutional market are not due to differences in bargaining power. Legitimate wages are not determined by bargaining power. but by natural laws. Differences in wages are due chiefly to differences in the quality of labor. Differences in technical wages in different sections are often explained by the fact that wage earners take into consideration things outside of technical wages that are of value to them in accepting employment.

When a group of employees in any industry as the automobile business band together and by means of compulsion force those in charge to pay them more than the market price for their services, what is the real nature and economic effect of such action? In the first place a contract made by compulsion from either side is not a contract. In the second place this group withdraws from the open, competitive market, repudiates the market value standard of wages, and substitutes for it an arbitrary, artificial standard, dictated by themselves. The amount above the market value of their services is really a bonus they obtain by compulsion, and they dictate the amount and the conditions of the bonus.

This bonus, misnamed "higher wages," and other special costly privileges obtained by threats of injury, are of necessity added to the cost of production, then added to price and assessed on the consumers. Capital investors suffer a loss in being deprived of the constitutional right to direct their own business, but the great and continuous loss falls on consumers in higher prices that they must pay to keep up the series of bonuses to a privileged class of wage dictators. Those who force this unwarranted and unjust tribute from the millions of consumers receive higher wages than those they exploit without the tribute—but in the name of "social justice" they demand the tribute.

Employers fight this movement because the unwarranted and un-American restrictions it imposes take the direction of their own business out of their hands. and thereby defeats the efficiency that is essential to the highest success, and because it places their business at the mercy of an irresponsible, hostile dictatorship. But in the fight that employers, loyal to American ideals of freedom are waging they are fighting in the interest of the consumers against those who would live in the sweat of the consumers' faces.

However, many consumers in their ignorance, will continue to follow agitators and demagogues in their demands for still greater tribute from those who toil under a hallucination that these agitators and demagogues are their friends.—*Gus W. Dyer, Professor of Economics and Sociology, Vanderbilt University.*

RAYON STAPLE

THE increasing use of rayon staple fiber in woolen and worsted mills bids fair to re-enact the development of rayon filament yarn itself many years ago. First used as a substitute for wool, the woolen and worsted weavers are beginning to realize the advantages of rayon staple fiber as possessing qualities which give fabrics varied, and hitherto-unobtainable, new effects. Thus rayon staple fiber is beginning to be used boldly "for its own sake" rather than as a subversive adulterant for wool.

Technical development is also bringing new effects to staple fiber, as made both by the viscose and acetate processes—staple with a permanent crinkle in it to afford good fiber interlocking in a yarn, spun rayon fabrics that are as warm or even warmer than wool (due to the insulating air spaces created in the fabric, of course), staple rayon fabrics with an extremely soft "hand," and fabrics with cross dye and other style effects which are entirely new. Such factors as these give weight to the concept that rayon staple fiber is an entirely new product, standing on its own merits, and is not simply "just as good as" some other fiber.—*Rayon Organon.*

Naphthols—Cold or Hot?*

H. I. CRESLOW

NAPHTHOL dyeing presents to the warp dyer a problem capable of two very different solutions. On the one hand, he can apply these dyestuffs by the old and well-established methods given in the literature supplied by the makers of the products. While these processes have proved themselves to be very efficient in certain directions, they very definitely have limits, beyond which good results are much more difficult to obtain. In addition to the usual difficulties peculiar to this class of cotton dyestuffs, the warp dyer has three main problems to consider.

PENETRATION

The first is penetration. This is a never-ending source of worry to a warp dyer, and the trouble is by no means limited to naphthol colors, but is common to the application of all classes of color to this type of material. Except in the case of naphthol colors, the difficulty is usually overcome by either the judicious application of auxiliary products through the dyebath, or both. Such methods, unfortunately, cannot be said to be an unmixed blessing in the case of the naphthols. With this class of dyestuff, the use of auxiliary products, while being beneficial in assisting penetration, definitely retards the rate of absorption of the naphthol by the cotton. Secondly, the repeated passage of naphthol-dyed yarn through naphthol and diazo solutions produces a dyeing which, instead of being simply a development of color on and in the yarn, is actually a development of *some* color on and in the yarn, followed by repeated developments of *color on color,* according to the number of passages through the dyebath. Such a dyeing can and almost invariably does give rise to serious rubbing troubles.

To get over this difficulty the warp dyer has to fall back on the use of dye-baths of large volume and trust that the length of time taken for the yarn to pass through such a volume of liquor, will be sufficient to ensure thorough penetration of the yarn.

SURPLUS LIQUOR

The second point which has to be considered arises entirely out of the first and is the problem of what to do with the large volume of liquor after a dyeing has been completed, bearing in mind the high cost of the dyestuffs in the bath and the very poor exhaustion obtained with this type of dyeing. The dyer can either let the liquor go down the drains—a policy which cannot be looked upon as economical—or he can store the naphthol solution and allow only the diazo solution to run to waste. Certain products are recommended to be added to the naphthol solutions to facilitate storage, but even so, the time they will keep in a satisfactory condition is limited. Serious rubbing troubles can again be caused by too long a storage of naphthols. In addition, it is not always convenient to store such solutions in the machines and it is necessary to transfer them to other vessels, which both costs money and takes time.

The third point—and I think the most important one—is that by this method of dyeing, the use of the naphthols is practically limited to a straight dyeing and any attempt at mixing naphthols is beset with pitfalls, unless the substantivity of the particular naphthols is practically identical. Attempts to mix naphthols whose substantivities are very different can give rise to any amount of trouble when it is necessary to feed the bath during dyeing. Owing to the very short time of immersion of the yarn in the bath and the very different rates at which the components of that bath are being absorbed by the yarn, it is almost an impossibility correctly to estimate the amounts of each constituent which are necessary to correct that absorption. To bring such a dyeing to a satisfactory conclusion it is necessary to have someone in charge of the machine who is thoroughly conversant with these differences of substantivity, and will be able to make the necessary changes in concentration. So much for the well-established method.

DISADVANTAGES OF OLD METHOD

Before giving details of any alternative method, it will perhaps be a sound idea to sum up again the disadvantages of the old method, deal with each difficulty separately from another standpoint and finally give a full method incorporating the points springing out of these new standpoints.

Here are the difficulties again:

(1) Difficulty of penetration.

(2) Difficulty of economical use of old dyebath.

(3) Difficulty of difference in substantivity of different naphthols.

(1) *Alternative method of dealing with penetration difficulty.*—

In the dyeing of colors where the baths are used at the boil, a large amount of the penetration is obtained by the mechanical action of the boiling bath. The boiling causes a very rapid replenishment of that region of the liquor which is becoming weakened by the actual dyeing process. There is obtained by boiling an almost constant concentra-

*The Dyer and Textile Printer.

tion of dyestuff at all points where the yarn is in contact with the liquor. It gives the yarn an opportunity of having at all times a sufficiency of dyestuff to travel through the material. This can be called a pressure of dyestuff on the yarn and providing the pressure of dyestuff is not allowed to fall it will continue to pass through the yarn in exactly the same way as water or gas will pass through a pipe as long as the pressure at the source is applied.

BOILING BATH

This being the case, it would appear that if the naphthols could be applied at the boil, it would be possible to use a short bath and obtain the same or better penetration than that obtained by a very long bath used cold. This has been proved to be the case, but the difficulty lies in the fact, that whereas naphthol baths will stand any temperature up to the boil, the diazo solutions are affected in varying degree by any change in the temperature. Some of the diazo solutions are destroyed by only small rises in temperature, while others are stable up to comparatively high temperatures. Because of this, if boiling naphthols are to be used as a means of overcoming penetration difficulties, some arrangements must be made subsequently to cool the yarn before it is allowed to enter the diazo solution, or a gradual rise in temperature will ensue which will ultimately cause the bath to break down.

(2) *Economical use of the old dyebath.*—

The surmounting of this obstacle becomes a matter of only small importance if boiling naphthol baths are found to be practicable. It has been found that the volume of a cold naphthol bath is out of all proportion to the volume of the boiling naphthol bath which is required to give the same degree of penetration. It has further been shown that a bath having a volume just sufficient completely to immerse the amount of yarn which is passing through it at any given time, can be made to give a satisfactory penetration if it is used at the boil.

FULL BOIL NECESSARY

It is, of course, important to remember that when using a method of this description, the term "boiling" must mean the full boil, because the penetration is dependent on the mechanical agitation of the dyebath caused by this actual boiling. Since it is possible to use such small volumes and at the same time to obtain satisfactory penetration, the wastage of such a small amount of dyebath at the end of the dyeing is not a serious matter and therefore the second difficulty is more or less automatically disposed of.

(3) *Extended use of mixed Naphthols owing to control of substantivity.*

Fortunately for the success of the hot method of applying naphthols the difficulty of different substantivities becomes quite the simplest part of the whole operation. By raising the temperature of a naphthol solution its substantivity is correspondingly decreased, until a point is reached at which it can be said to be practically non-existent. This means, that starting with the whole range of naphthols having varying substantivities a point can be reached at which all these substantivities are to all intents and purposes the same. That temperature is boiling point, and the common substantivity is nil, or as near nil as makes no difference. Again it must be stressed that this boiling point must be kept constant, because although slight drops in temperature will make no appreciable difference to the less substantive naphthols, they will make a definite difference to the more substantive ones.

A PADDING PROCESS

Of course, the reduction of substantivity to nil means that the actual affinity of the naphthol for the yarn is now nil, and the operation becomes one of impregnating or padding only, instead of the former process, which was a combination of both impregnation and dyeing, the amount of dyeing depending on the substantivity of the particular naphthol body.

It follows that the concentration of the naphtholating bath will now have to be increased, because no actual dyeing is taking place, the process being merely an impregnation. This does not mean an increase in the cost of the dyebath since the greatly reduced volume used with this method means that the amount of naphthol required to set a dyebath is only a fraction of that required to set the much larger volume used in the older method. It must not be inferred from this last sentence that dyeings by the hot method will invariably be much cheaper than those produced by the cold method: a considerably larger amount will be required by the hot method for feeding and this will level things out. The actual saving will be found to be in the wastage factor of the two methods.

The most important point to be gathered at this stage is that the substantivities of the naphthols are now in a state in which the warp dyer has a reasonable chance of controlling them, and this therefore is a method of surmounting the third difficulty.

PRESENT METHOD AND MACHINES

It now remains to be seen if the present cold method and the existing machinery can be adapted and modified to suit the requirements of a hot process.

Practical application of the hot naphthol bath on cotton warps.

The following is a general description of the process:

The yarn is entered dry into a boiling solution of a naphthol or naphthols, the volume of the bath to be the smallest possible to allow of proper control. The yarn on leaving the bath passes through very efficient squeezing rollers. A passage through air is now given to cool the yarn, followed by another efficient squeeze. The yarn now enters the diazo bath, which can be made of the usual strength or can consist of two small concentrated baths with an efficient squeeze in between. The yarn after development is washed and aftertreated in the usual manner.

VOLUME OF NAPHTHOL BATH

It is not advisable to reduce this to the absolute limit at which penetration can be obtained. The chief reason is that the smaller the volume the more susceptible it becomes to a drop in temperature caused by the entry of cold yarn into the bath. From experiments carried out, it is found that a very useful volume to base on is six pints of naphthol to each warp. The passage of the yarn through the naphthol must then be arranged to give the maximum amount of immersion before the yarn leaves the bath. This can be done by various methods and any remarks on the subject here would be superfluous. Local conditions will decide this point. The important thing to be remembered about this process is that the bath must be kept at the boil. It is advisable to make arrangements for the operative to be in a position actually to see the bath boiling.

CONSTANT VOLUME ESSENTIAL

Another important factor to be kept carefully under control in this operation is that the volume be kept constant during the whole of the dyeing. This is of the greatest importance because any variation in the volume would allow some parts of the yarn to pick up more liquor than other parts, which would result in variation of shade. The best way to ensure constancy is to arrange a system of continuous feeding, the feeding solution to be of the same concentration as the bath itself.

The importance of keeping the bath boiling is also obvious. If the temperature is allowed to fall, the naphthol regains substantivity and so the dyebath loses some of its concentration, with the result that the feeding solution is now stronger than the bath, and the equilibrium is upset, and cannot accurately be regained, as the concentration of the dyebath is now an unknown quantity.

Assuming this factor to be properly under control, the rate of feeding will depend on two factors, the weight of yarn passing through the bath at any given time, and the amount of naphthol liquor which the squeezing arrangements will allow to be carried through by the yarn.

SQUEEZING ARRANGEMENTS

The question of squeezing is very important. A number of the troubles associated with azoic colors can be traced to insufficient attention to the squeezing arrangements. The point is of paramount importance in the dyeing of hot naphthols. It is during the actual squeezing that the depth of the shade is determined. In the hot dyeing of naphthols it is satisfactory to have the degree of squeezing on any particular machine set at a point which has been proved to give the result required, and then to make provision for that setting to be used for all dyeings on that machine. The squeezing should be adjusted to give a uniform squeeze through the yarn, and it must be of an efficiency that ensures that no concentrations of naphthol are carried through at the sides of the yarn.

SQUEEZE ROLLS

Care must be taken that all the squeezing rollers are in very good condition, and have no grooves or hollows in them. Rubber rollers, or rubber top rollers and ebonite-covered bottom rollers can be used, but particular attention must be paid to their upkeep. Rubber rollers often give bad results after a short time, owing to local hardening or softening of the rubber. These variations are not always visible to the eye, but they are sufficient to allow the naphthol to pass through in an uneven condition. It is a matter of opinion, of course, but in the writer's view, rollers covered with hessian or woolen, or both, give the best results. The use of woolen is rather expensive on rollers for squeezing liquors containing caustic soda, but by covering the woolen with a layer of hessian it can be made to last quite a long time. The advantage of these covered rollers over the other types lies in the fact that any excess of naphthol carried at the sides of the yarn is absorbed by the covering.

If proper arrangements are made it will be found possible to make the squeezing so effective as to produce a yarn evenly squeezed throughout. The squeezing should be as powerful as is consistent with the proper running of the machine. If the squeezing allows too much naphthol to be carried through two faults may ensure. First, there is a risk of the excess of naphthol being coupled with the diazo bath and gradually exhausting that bath. Secondly, that excess of developed color carried by the yarn is very difficult to remove and gives rise to rubbing troubles when finished.

COOLING ARRANGEMENTS

There are many ways of fixing up an arrangement to cool the warps, and a decision on this point will rest to a large extent on the conditions and facilities available in each individual dyehouse. A cheap, and at the same time satisfactory, method is to carry the warps up to the roof, over rollers and then back to machine level, repeating this as many times as there is room for it. It will be found that the yarn cools down fairly quickly, and such a layout takes up very little extra room. Alternatively, the warps can be made to travel in a horizontal direction over the machine, and back to the squeezing head. The first method is more satisfactory than the second one, as the cooling takes place more rapidly and is more thorough. More elaborate methods can be constructed if necessary, such as passing the warps through a specially constructed chamber in which a current of air is circulated by means of a fan, which first forces the air through ice. Provided the yarn can be cooled practically to normal temperature, any cooling system can be used.

The second squeezing.—

This should be as efficient as the first, as it has a two-fold purpose. In addition to being a check on the efficiency of the previous squeeze, it tends to redistribute the naphthol on the yarn and so facilitates the proper cooling.

The Diazo Bath.—

As already stated, this can either be a single volume, low concentration bath, or can consist of two, small volume, high concentration baths. The first method is satisfactory providing the bath is kept in a fresh condition. The point should be carefully watched, as any wearing of the naphthol squeezing arrangements, with the consequent carrying through of excess naphthol, will soon cause the bath to become fouled. A further fact to note is that the time required to develop these colors varies according to the nature of the diazo compound. It has been shown that diazo bodies which are slow to develop can be assisted in their development by the use of more concentrated solutions. A large volume, low concentration bath, therefore increases the risk of incomplete development taking place. With the other type of diazo bath, rapid development takes place and moreover the squeeze between the two baths ensures a thorough penetration of the diazo solution to all parts of the yarn. Again, should there be any leakage of naphthol through the first squeezing the fouling of the diazo solution in the first bath is obvious and steps can be taken to avoid a spoiled dyeing by increased feeding in the second bath.

The aftertreatment.

This as a rule consists of a thorough washing with water, followed by one or more passages through boiling soap and soda baths. The extent of this treatment again depends on the particular combination which is being used. No mention will be made here of the use of any of the auxiliary products recommended to assist in curing rubbing troubles, etc., as the efficacy of these many and varied products is a matter on which opinions differ. However, the use, misuse, or disuse of these products makes no difference to the comparison of the two methods of applying naphthols.

Having decided to use hot naphthols, one may gain quite a number of interesting facts from their application. For instance, it is possible to work out accurately the amount of naphthol required to produce a definite shade on any amount of yarn. This can in turn be accurately divided into bath and feeding. Further calculation can be made to show the amounts of diazo compound which will be required for bath and feeding. Thus it is possible to get out the material cost of a dyeing before it actually takes place, which is of tremendous value when quotations have to be made. In the cold method of applying naphthols, these facts are generally dependent on whether or not the dyeing has been actually done before, and if so whether accurate records were taken at the time.

OBTAINING DATA FOR PRE-COSTING

First, find out the amount of liquor that any given weight of yarn will take out of the bath. This is done by setting the squeezers on the naphthol box in exactly the way you mean to use them when dyeing. Then take a warp of, say, ten pounds in weight, and pass it through this naphthol box, which has been charged with a known volume of naphthol solution, which is being kept at the boil. As the warp is passing through, keep the level of the bath constant by allowing to run in a measured volume of naphthol solution of the same concentration as the bath. The amount required to do this is the amount of naphthol taken up by the yarn. It will be found that this amount will vary slightly according to the count of the yarn. The biggest variation is, of course, with counts as far apart as possible. If you are going to deal with a big variation in counts it is as well to take two or even more readings of this, and use them for the various counts. There is not much variation when the counts are fairly near, and for people dyeing yarn of this type one reading is sufficient.

VOLUME OF BATH MUST BE CONSTANT

The important thing to remember is that the volume of the bath must always be the same. Feeding arrangements must be fitted to allow a constant flow of boiling naphthol to keep the volume of the bath at the constant level. For the purpose of making this easier to follow, we will refer to this constant volume as X. Next, take the volume of liquor which was taken out by the ten pound warp, and divide it by ten. The result of this is the volume of liquor which is taken out by one pound of yarn. We will refer to this as Y.

From this we get the following:

The volume of liquor which will be required to keep the volume constant for any weight of yarn is,

Weight of Yarn times Y

To set the machine for a dyeing, fill the bath to the required level, and add to it the smallest quantity of naphthol you are likely to use on any dyeing, e.g. ¼ oz. Now pass through the machine a piece of yarn, and when it comes out of the diazo box, aftertreat it properly and dry. It will probably be a long way from the shade you are aiming at, but keep it and make a record of how much naphthol was in the machine. Next add another ¼ oz., and repeat. Continue doing this until you obtain the required shade, in each case making a record of the shade obtained and the amount of naphthol required to obtain it. This may seem to be a laborious process, but it is only necessary to go through it once for each naphthol that you use, and then the records you have obtained will be of use for any subsequent dyeings. These results we call the initial concentrations.

Assuming this to be done, when it is necessary to get the machine ready to dye a shade, the following details have to be worked out:

(1) The initial concentration is obtained from the dyed records.

(2) The amount of naphthol required for feeding is obtained as follows:

$$\frac{\text{Weight of yarn times initial concentration}}{X} = \text{Ounces of naphthol.}$$

(3) The volume of feeding in which this naphthol must be dissolved is,

Weight of yarn times Y

That gives all the information which is necessary for the naphthol bath.

DEVELOPING BATH

The strength of this and the amount required depend entirely on the naphthol quantities. Information is given by the manufacturers of these products, as to the combining ratios of the diazo bodies with the naphthols, and use must be made of these. They are to be found usually in the pattern cards, but if not there they will be supplied on application. To calculate the amount required to set the bath, multiply the naphthol initial concentration by the combining ratio of the particular diazo compound you are using. You may find that with low concentrations of naphthol you do not get good developing. This is probably due to the volume of the developing bath, and can be corrected by making an increase in these concentrations for light shades, or by reducing the volume. Where only occasional light shades are done, it is best to increase the concentration.

FEEDING THE DIAZO BATH

To obtain the amount required for feeding the diazo bath multiply the ounces of naphthol feeding by the combining ratio of the diazo compound. Having obtained these, you have at your disposal all the facts necessary to either carry out a dyeing or cost one prior to the dyeing.

It has always been a difficult matter to apply azoic colors on cotton yarn by any method of calculation for reasons obvious to a warp dyer, but this method of applying the naphthols at the boil provides a reasonable chance of approaching theory costs.

TRADE NOTES — NEW PRODUCTS

• JOINS du PONT COMPANY

Carl H. Geister, until recently with the Mellon Institute of Industrial Research in Pittsburgh, has joined the Technical Laboratory staff of the Dyestuffs Division of E. I. du Pont de Nemours & Company, Wilmington, Delaware. His experience covers a broad field of research in the application of dyes and dyeing assistants. During his Fellowship at the Mellon Institute he spent six years at the tannery of Robert H. Foerderer, Inc., Philadelphia, Pa. His work there was primarily devoted to development and control problems involving the normal soaking, beaming, tanning, coloring, drying, finishing and grading processes on various types of leather, among which were vici glazed kid, vici special kid and velvet upper leathers.

Mr. Geister's practical experience in laboratory and plant work in the leather industry will be valuable in helping solve the technical problems with which the laboratory constantly has to deal.

Mr. Geister will be engaged in research, particularly on the application of dyestuffs to leather as well as promoting the use of Fine Chemicals products as tanning and dyeing aids.

• REVIVING INDIGO CULTIVATION

Depreciation of the Dutch guilder with consequent increase in prices of imported synthetic dyes into Netherland India has resulted in a marked revival of interest in indigo cultivation in that country, according to reports to the Department of Commerce from the American Trade Commissioner at Batavia.

The islands making up Netherland India were at one time important producers and exporters of natural indigo, shipments to Singapore alone aggregating 1,181 metric tons, valued at 7,793,000 guilders (approximately $3,200,000) during the years 1915-19, the report states. Following the war, however, when Germany resumed the exportation of synthetic indigo, the natural product of Netherland India was displaced almost entirely both in domestic and foreign trade. With depreciation of the guilder, however, prices of imported synthetic indigo rose to the point where planters began to renew interest in growing natural indigo, the Trade Commissioner reported.

Netherland Indian reports state that the possibilities of extending the cultivation of natural indigo are by no means remote as low wages obtaining in villages now render it impossible to turn out the dye at prices more competitive with imported synthetics, it was stated.

The reports state further that although the price of the local natural product may still be slightly higher than imported synthetic dyes the difference will be more than made up by the development of a domestic source of dyestuffs for native batik makers who use considerable quantities of indigo in their ancient handicraft, according to the Trade Commissioner.

• STYLE SHOW

Dr. Thomas Nelson announced recently that the home economics departments of twelve North Carolina colleges have accepted the invitation of the State College Textile School to participate in the annual Style Show, which will be held in connection with the Students' Textile Exposition on Thursday, April 22.

All the costumes displayed in this style show are made by young women, as a part of their classroom work in home economics, from fabrics designed and woven at State College by textile students. It demonstrates the variety and utility of fabrics produced at State College and shows the high caliber of work which the students there and in the cooperating colleges are doing to prepare themselves for a life of usefulness. Conducted annually since 1928, this style show has grown so large that it has been necessary to restrict the number of participants from each institution to 15. It is expected that approximately 160 young women will take part in this event.

• JOINS CHEMICAL CONSULTANTS

Frederick S. Bacon, for seven years chemical engineer for the Boston Blacking and Chemical Co., Cambridge, Mass., resigned that position on February 1, 1937. to join the staff of Gustavus J. Esselen, Inc., chemical consultants, 857 Boylston Street, Boston, Mass. Mr. Bacon, a graduate of Harvard College in the class of 1915, is well known in chemical and industrial circles in New England as a specialist in dyes, finishes, adhesives and lacquers. He was previously connected with Monsanto Chemical Co., Arthur D. Little, Inc., and Puritan Dye and Chemical Co., Northboro, Mass., a company which he formed and operated. He is a member of the American Chemical Society (Treasurer, Northeastern Section), the American Institute of Chemical Engineers and Alpha Chi Sigma. In addition to his chemical activities, Mr. Bacon is trustee of the Newton Savings Bank and director of the Newton Y.M.C.A., Newton, Mass.

• CHEMICAL EXPORTS

Despite the many devices set up during recent years to control and limit the import trade of a number of important foreign markets for American products, world demand for American chemical products continues to expand steadily, according to T. W. Delahanty, Acting Chief of the Commerce Department's Chemical Division.

Exports of such products during 1936 aggregated $154,000,000 in value, an increase of 13 per cent over the preceding year, 24 per cent higher than in 1934, and a 43 per cent increase over 1933, during which the value of our chemical export trade was recorded at $107,350,000, it was stated.

All staple chemical commodities entering into our export trade recorded substantial gains in 1936, preliminary statistics show, and a number of relatively new products such as plastics, synthetic resins, heating and refrigerating gases, and a number of other items were rapidly attaining positions of importance, he stated.

• JOINS WARWICK

Mr. Robert Pinault, formerly with the Celanese Corporation in Cumberland, Md., and the United States Finishing Co., Sterling, Conn., branch, has recently joined the technical staff of the Warwick Chemical Company, West Warwick, R. I.

• PERMUTIT SALES MANAGER

Daniel J. Saunders has been named manager of industrial sales for the Permutit Company, New York, manufacturers of water conditioning equipment. Mr. Saunders has been with the company for seventeen years and has recently been assistant manager of industrial sales.

• BRITISH COLOUR COUNCIL

The British Colour Council which was formed in England during 1930 for the purpose of coordinating and propagating industrial color tendencies is at present conducting a coronation "paint-up" campaign, according to a report from the American Trade Commissioner at London, made public by the Commerce Department's Chemical Division.

The Colour Council, composed of 800 firms, has received the enthusiastic endorsement of British dye and color manufacturers since its inception. Functions of the council at the time of its formation were stated to be "to determine, coordinate and propagate color tendencies for fashion and allied trades and other trades in the British Empire; to standardize the names and numbers of colors; and to promote the adoption of color nomenclature, shade cards, equitable forms of contracts and other documents used in the trade."

During 1934 the Council issued a color chart entitled "Marine Colors," in 1935 "Jubilee Colors" were displayed, and last year a "Coronation Colors" chart was released to industry, according to the report.

• NEW TAG CATALOG

The C. J. Tagliabue Mfg. Co. of Park and Nostrand Aves., Brooklyn, N. Y., announce the publication of a new TAG Laboratory Thermometer and Hydrometer catalog, No. 1100A.

In addition to the regular line of extreme precision and standard grade TAG Thermometers and Hydrometers, this new catalog now includes complete listings of the widely used A.S.T.M. Thermometers with illustrations, also the well known TAG-A.P.I. and TAG Certified hydrometers.

Useful data including comparison scale graduations, corrections for emergent stems, instructions for using hydrometers and Fahrenheit and Centigrade conversion tables are retained and amplified.

A catalog will be sent free by the manufacturer on request.

• NICKELSWORTH

Copies of *Nickelsworth*, publication of the International Nickel Co., Inc., 67 Wall Street, New York City, for the first quarter of 1937 have recently been distributed. Among the items of interest to wet processors of textiles is one concerning the use of nickel alloys in Rapidogen print agers. Copies of the publication are available upon request.

• GENERAL RELEASE

General Dyestuff Corp., 435 Hudson Street, New York City, announces release of a circular on the following product:

Diamine Orange BA—a direct dyestuff especially recommended by the manufacturers for the dyeing of silk-cotton unions and said to be of particular interest for hosiery dyers.—Circular G-156.

• PROMOTION OF "IMPREGNOLE"

Mr. E. Nathan, president of the Warwick Chemical Company of West Warwick, R. I., announced the opening in New York City of a separate Sales and Sales Promotion Department of "Impregnole," one of the company's chief products, with offices at 580 Fifth Avenue. Mr. Nathan plans launching an extensive campaign to popularize "Impregnole" with the consumer, retailer, manufacturer, finisher and mill. "Impregnole," claimed to be one of the best spot and water-repellent processes known, has affiliated companies in France, Germany, Italy, Switzerland and South America, and has been successfully used for many years. It is said to be employed in a diversity of climates, its porosity especially adapting it for service in warmer latitudes.

Mr. William Oseasohn, recently appointed Sales and Sales Promotion Manager, was executive director of several of the sub-divisional code authorities of the Cotton Garment Industry, and has for many years been a sales and marketing consultant in the men's and women's wearing apparel fields.

• MEETING, S.O.C.I.

A meeting of the Society of Chemical Industry, American Section, was held on February 19th at the Chemists' Club, 52 East 41st Street, New York City. Mr. James G. Vail was the chairman. The guest speaker was Dr. Wallace P. Cohoe who spoke on the subject, "Permanent Sizing with Alkali Soluble Cellulose Ethers."

According to Dr. Cohoe, impermanent sizing with starch has been practiced in the textile industry from time immemorial. Queen Elizabeth granted a monopoly for starch at the time when the stiffening of Tudor ruffs made such a monopoly valuable. Then, as now, it is a case for resizing upon every visit to the laundry.

Much starch is used today in the finishing of cotton for the purpose of giving cloth an appearance and weight which it really does not possess. This fictitious improvement is an economic loss. A permanent sizing, on the other hand, not only lasts for the life of the cloth, but improves its intrinsic quality, he said.

The alkali soluble cellulose ethers of Lilienfeld when applied to cotton cloth, put into it a permanently retained product which is almost identical chemically with the fibers themselves and impart to cotton an appearance and handle resembling linen, Dr. Cohoe said.

Dr. Cohoe described the various classes of ethers now available for sizing. He also discussed methods of solution, application and precipitation. He showed samples of certain ethers and their solutions.

Dr. Cohoe has specialized in the chemistry of textiles, doing pioneer work on the application of viscose in permanent sizing, and developing methods and machinery for the continuous application of vat colors to cotton and silk. He is the original inventor of a method for continuous extrusion of cellulose tubing today widely used as sausage casings and bottle bands. He has contributed to the chemistry of the conversion of ligno-cellulose waste into fermentable sugars.

• NEW GENERAL BUILDING

Representatives of trade papers in the textile field were recently taken on a tour of inspection of the new General Dyestuff building located at 435 Hudson Street, New York City. The building is of the latest and best in modern architecture and has been designed to be as satisfying in appearance, both in its internal and external aspects, as it is efficient. The offices, laboratories, warehouse and shipping rooms have all been combined and equipped with facilities for service.

The reception room, executive offices and directors' room are well lighted by means of structural glass brick and high wide windows as are the office departments. The floors are of rubber linoleum and together with the acoustical ceilings control and absorb sound.

The laboratories are located on the 9th floor and cover 25,000 square feet of floor space. The walls are seventeen feet high and there is an insulated roof of structural glass bricks which transmit 86½ per cent of the available light. The floors of the laboratories are of acid proof tile and acid proof drains have been installed. Stainless metal equipment has been installed. The heating units are electrical and there are 80 electric motors for driving the various pieces of laboratory and testing equipment. The apparatus and equipment are of the most modern type and arranged in carefully planned sequence so as to give the maximum efficiency in the flow of work. A number of views of the laboratory are shown in the accompanying illustrations. The laboratories, which are under the direction of Dr. W. H. Cotton, are at the service of consumers of dyestuffs for wool, cotton, silk, rayon and various mixed fibers.

Six floors are devoted to warehouse purposes and containers are packed and stored according to methods that facilitate their handling and give protection to the products within. A fleet of trucks is maintained by General and are operated by drivers and helpers trained in the proper handling of dyestuffs.

The illustrations are typical of scenes in the textile laboratories at the new General Dyestuff Building.

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CHEMIST WANTED: Established dyestuff manufacturer wishes to contact experienced organic chemist familiar with dyestuff and intermediate development and manufacture. All applications will be treated strictly confidential. Write Box No. 941, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.